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NEWS AND VIEWS

The next instalment of the Revised Indexed Check-list of the British Lepidoptera by I. R. P. Heslop will be the GEOMETROIDEA section and will appear in the July issue. We take this opportunity to remind readers that the scientific names, i.e. the generic and specific nomenclature, in this list have been adopted by Mr. Heslop after consultation with specialists in the various groups. The changes in the names of certain species come about as a result of research and advancement in the field of zoological nomenclature. Such changes can be particularly annoying to the collector but are inevitable if we are to progress towards a stabilized nomenclature. None has been made without reason, though sometimes the reason is clear only to the specialist.

Some readers have commented on the family arrangement used by Mr. Heslop. We must emphasize that the general arrangement of the list is essentially his own, as he states in his Introduction. Readers who feel strongly on this subject are invited to express in these columns their own views on the systematic arrangement of the British Lepidoptera.

AUTUMN EMERGENCE OF *PERIZOMA SAGITTATA* F. (LEP., GEOMETRIDAE)

From a number of pupae of this species, being kept together in an outshed, one moth emerged in October, 1959.

G. HAGGETT.

TRINOPHYLUM CRIBRATUM BATES IN MIDDLESEX, 1959 (COLEOPT., CERAMBYCIDAE)

The Feltham timber yard, which was the breeding place of *T. cribratum,* has been largely destroyed during 1959 by having houses built on more than three-quarters of its area.

The following records are therefore of particular interest, as they may well be the last from Feltham (I do not know whether the colonies at the Poplar and Cowes, I.O.W., timber yards still exist). The five specimens noted (males) were taken in or on the mercury vapour light trap in my garden: one 22nd June, one 25th June, two 3rd July, one 4th July.

E. W. CLASSEY.

22 Harlington Road East,
Feltham, Middlesex.

AN HERMAPHRODITE *ANTHOCHARIS CARDAMINES* L. (LEP., PIERIDAE)

I have been asked by Mr. Paul Williams, of Monkstown, Co. Dublin, to record, on his behalf, the capture of a half and half hermaphrodite *Anthocharis cardamines* L., at Ballycorus, Co. Dublin, on 10th May of this year. The specimen, which I have seen, is a very fine one, the left side being entirely male, and the right side entirely female.

E. S. A. BAYNES.

2 Arkendale Road,
Glenageary, Co. Dublin.

CORRECTION

In part IV of our paper on parasites of Lepidoptera (1960, *Ent. Gaz.*, **11**: 52) the locality for *Plusia chryson* Esp. (under *Campoletis punctata* Br.) is in error. While the material was sent to us from West Sussex, we understand that it was actually collected at Wherwell, Hampshire.

H. E. HAMMOND AND K. G. V. SMITH.

THE AQUATIC COLEOPTERA OF SCOTLAND AND THEIR ROUTES OF ARRIVAL

By FRANK BALFOUR-BROWNE, M.A. (Oxon. et Cantab.), F.R.S.E.
Formerly Professor of Entomology, Imperial College, London

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I—INTRODUCTION

There are many branches of work in biology, but they have all evolved from the study of animals and plants in their natural surroundings. When the evolution began it created a gap, which gradually widened, between the nature students and those who, having had some experience in schools and universities, became trained biologists, and whereas the nature students (amateurs) still continued their field observations and their collecting of specimens, the trained individuals became more and more confined to laboratory work and developed a mild scorn for the naturalists. The evolution of these advanced biologists has gone so far that we now have a number of different branches of biological research, systematics, physiology, genetics, embryology, palaeontology, mathematical biology, etc., diverging from one another and developing different languages.

There have, however, always been professionals with a taste for natural history as such, and they have associated themselves with the amateurs in the local societies, and as these professionals began to see the gradual specializing of these branches, they recognized the necessity for keeping in touch with amateur work. At the York meeting of the British Association in 1932, a joint meeting of the botanical and zoological sections approved the proposal of the late Professor Fritch that there should be a Freshwater Biological Association, the first step made by the zoologists towards field work as such, the botanists having always kept in touch with such work.

At the working centre of the Association, professionals and amateurs can work side by side in the study of living things.

In 1943 a proposal by Dr. F. H. C. Butler caused the formation of a Council for the Promotion of Field Studies, now the Field Studies Council, and a few years later a Scottish Field Studies Council was inaugurated.

We therefore now have definite field studies being carried out by established and well-supported bodies, and the classes held in the various centres attract the school-age enthusiasts and anyone who cares to apply for attendance at a course, and it is largely because of the success of these bodies that it became possible to get official support which resulted in the creation of the Nature Conservancy at the end of 1949. This body, after many teething troubles, some of these serious, has every chance of doing really valuable work.

The foundation of any work of conservation requires a knowledge of the fauna and flora, and therefore one of the early objects should have been to obtain as complete lists as possible of the animals and plants and their distribution in the Britannic area. It is on such knowledge that so much depends. For instance, the distribution of animals has been studied mainly over vast areas of the earth, largely with a view to forming theories as to changes in the land masses, while little attention has been paid, except by some amateurs, to the Britannic distribution of most of the animal groups. By having at any one date a knowledge of the range of an animal, a survey at a later date will give information as to changes in such range and will provide material for discussing the causes of the change.

Taking insects as an example, there are lists of some of the Orders for some of the areas in the country. So far as I know there has been no attempt by the Conservancy to decide upon an official division of the country into areas! We entomologists have been using the vice-county system introduced by H. C. Watson in 1859 (52)*, and it seems that there is in preparation a modifying system which will undoubtedly cause confusion if it is published. Therefore, one of the first acts of the Conservancy should be to declare a system on which records should be entered, and I suggest that they could with advantage adopt the system which has been in use in this country for many years (9)* and which, I believe, was first taken up among zoologists by the Conchological Society. An official statement by the Conservancy fixing the system would stop any modifications by individuals taking upon themselves to amend what is in use.

I have spent more than 60 years examining the water beetles, Hydradephaga and Hydrophilidae, of the Britannic area, and I have kept records, not only of the counties and vice-counties in which

* Numbers in brackets refer to the bibliography at the end of the paper.

each species has occurred, but also of the species associated together in each spot where I have worked. During my three years in East Norfolk, where I made an intensive search for water beetles, I made more than 2,000 collections, going to the same spots each month from about March until October. In Ireland, where I spent about six years, I made more than 100 collections in Antrim and more than 200 in Down, taking what opportunities I could to collect in other parts of the country. When I moved to Cambridge in 1913 my opportunities were fewer, but up to the time I left in 1925 I had made more than 140 collections. In Somerset, up to 1936, I made more than 300 collections, and from then on to 1940 in Sussex more than 100. Covering many periods from 1906 and until a few years ago I made more than 300 collections in Kirkcudbright and more than 130 in Dumfries.

These figures give some idea as to the time I have given to a study of the Britannic water beetles and expeditions of a few days to perhaps a fortnight into other counties in England, Scotland and Ireland, during which the work was intensive and ran to anything up to 80 collections, have added much additional information which is contained in my series of journals.

I have collected in 32 of the 40 Irish divisions, in 38 of the 41 Scottish, and in about 50 of the 71 English, so that, with additional information from specimens in Museums and from other coleopterists and from published lists of species and from lists received from many friends, I have what I suppose is an unique amount of material for justifying some speculation as to the distribution and origin of the British water beetles.

Before I discuss the question of distribution I should perhaps explain, as I have done on one or more previous occasions, what I mean by stating I have made so many collections. A collection consists of a series of workings of the net in a small area of a pond or loch or of running water. The contents of the net are emptied out on a sheet of white mackintosh and the beetles identified on the spot where possible and their names entered in a notebook, all the species from one collection being entered as one unit. Any species not readily identified in the field are taken home and their names added to the list. I endeavour to find all the species at the spot where I am making the collection before I move on elsewhere.

A series of repeated visits to the same spot in order to note changes in the water beetle associations does not give altogether reliable information because the disturbance of the vegetation and the general fauna and the removal of specimens must affect the results, but I regard these results as worth obtaining and as reliable for making deductions as the material used by some other lines of biological research.

I have already pointed out on various occasions that although the

occupied area of any species may appear to be continuous over a large area, it is actually broken up into a number of small areas, each occupied by a population of the species, but there is occasional or frequent interchange of individuals between these populations. In the case of the water beetles, these isolated areas are very well marked as separate ponds or lochs or river systems, and within each of these areas the actual limitations of each species are much smaller, depending upon habitat conditions. The habitat conditions are always changing, but the beetles may find suitable conditions by moving only a short distance to one side or the other. Naturally, a smaller pond will probably fail to suit a particular species before a larger one, and so with other types of water, and it is the long continuance of some kinds in the large lochs which have aroused in some the idea that the larger and geologically older lochs hold species which also date back far into the past.

The changes in environment which induce the beetles to move elsewhere may be temporary changes of weather, hotter, colder, drier, wetter, or lack of suitable cover or of suitable food or of sufficient food, especially when a new generation appears, so that the survival of any species depends upon its plasticity; i.e. its power of adjustment to changed conditions, or its capacity for finding another suitable habitat.

Thus there is almost continuous movement of individuals from one place to another, and the changing conditions not affecting different species in the same way result in changes in the composition of the communities occupying the various habitats.

We know that for some thousands of years our climate has been changing from arctic to temperate, and palaeontology tells us of the changes in the fauna and flora through long periods before, during and since the glacial period. It is therefore surprising how, until comparatively recently, no one seems to have studied our animals and plants from the point of view of their distribution and origin. Edward Forbes (1846) seems to have been the first to go into the subject and, after a short paper in connection with molluscs, he produced an essay entitled 'Geological Relations of the Fauna and Flora of the British Isles' (27). He divided up our fauna and flora into five groups according to their distribution in the Britannic area, and he explained these groups as the result of five different invasions from the Continent. One group, his 'Lusitanian', he regarded as the remnant of the fauna and flora which were preglacial, this group having been pushed westward and southward by the Scandinavian group which came with the glacial period, his three remaining groups being post-glacial. He explained that though many of the animals and plants could have arrived by air, some could only have come by land and, unfortunately, a number of more recent students of distribution have assumed that the majority of our species arrived in our

area before it became separated from the Continent. And this 'land-bridge' view has led some to the belief that any animal or plant present in Britain but absent from Ireland must have reached England after the formation of the Irish sea.

It may well be that some of our present water beetle species are the direct descendants of those which arrived during and immediately after the glacial period, but there is evidence among these, as I shall show, that there is constant movement of individuals and perhaps of parties of individuals, not only in but also into this country, and there is abundant evidence among the more conspicuous insects, such as butterflies, of regular and irregular invasions via what I have called the southern route (see page 86). It is only the more conspicuous species which can be detected, but if they are coming in why should not the inconspicuous ones be coming in also, and I suggest that it is these frequent invasions which keep up the stocks of the first arrivals.

A study of our water beetle distribution maps, which I have published in *British Water Beetles* (18), and some of which I have reproduced here, show how each species is dispersed in the Britannic area, and it has been said, and is doubtless true to some extent, that the maps show the amount of collecting and recording that has been done in each division. But admitting that much more collecting has been done in southern England than in Scotland does not explain the absence of species in the south which are present in the north. It will be said that this can be explained by climatic and edaphic factors, but it does not account for the limitation of species to parts only of areas for which they are apparently suited. It might be in some cases that a species requires a very special type of habitat, but this is certainly not true of most species, which have considerable powers of adaptation. I kept *Dytiscus lapponicus* in tubs in my garden in Down and later in Cambridge and bred them through three generations from specimens taken in a lochan 800 feet above sea level on Eigg, and I also bred in Down *Hydrophilus piceus* and *Hydrochara caraboides,* having obtained the parent specimens from Surrey.

Admitting that some of the examples I have used may not fit the case I am supporting, the majority of the species bear out my contention that the distribution maps indicate that there have been invasions of some northern species in the north and that the majority of our species, including a few north continental ones, e.g. *Agabus uliginosus, Hydrochus elongatus,* etc. (see maps 1 and 2), have arrived post-glacially in this country via the south-east coast route from, say, Holland, Belgium, France or Spain. Later I shall refer to these two routes, which are not narrow lanes of invasion, but my northern route covers the whole of the northern Scottish coast and the eastern British coast down to, perhaps, Yorks. or Lincs., while the southern

arrival route covers the whole south coast of England and part of the east coast, probably overlapping the northern route.

In the following list I have set out the Scottish species of the five families Haliplidae, Hygrobiidae, Dytiscidae, Gyrinidae and Hydrophilidae, which include about 165 species.† Some of these are doubtful and I have included a few varietal forms most of which have, at some time, been described as species, and for the purposes of this paper I have treated them as of equal standing with the species. With each species I have named the divisions from which it has been recorded, using the letters representing the counties and vice-counties as set out in the 'typomap' constructed by B. B. Woodward of the British Museum (Natural History) on the idea first suggested for Ireland in 1896 by R. L. Praeger * (39). I have added in each case the percentage of occurrence of the species indicating the number of the 41 divisions in which each has occurred.

† Omitting the Hydrophilid genera *Coelostoma, Sphaeridium, Cercyon, Megasternum* and *Cryptopleurum,* which are more terrestrial than aquatic.
* Or see the whole system set out in (9) or in (18), Vol. I, pp. 60-66.

II—LIST OF SPECIES WITH PERCENTAGES OF OCCURRENCES

Species	Vice-Counties	P.C. of Occ.
Brychius elevatus Panz.	DF, KB, AY, LA, PE, RX, BW, ED, SG, KF, BF, EL, EI, RE, NS, CA	39
Haliplus obliquus Fab.	DF, KB, LA, RX, BW, HD, KF, PM, FF, EL, I, M, CA, OI	34
„ *confinis* Steph.	DF, KB, AY, RF, LA, RX, BW, HD, KF, SG, PM, FF, AN, BF, EL, EI, AM, B, I, M, S, RW, NS, CA, HB, OI, SI ...	66
„ *flavicollis* Sturm	DF, KB, AY, RF, LA, SK, RX, KF, SG, EI, AM, B, NS ...	32
„ *fulvus* Fab.	DF, KB, WT, AY, RF, LA, PE, RX, BW, ED, KF, SG, PC, PM, PN, FF, KI, AS, AN, EL, EI, WI, AM, DN, B, CT, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	90
„ *variegatus* Sturm	PC, AS	5
„ *ruficollis* Deg.	DF, KB, AY, RF, LA, PE, RX, BW, HD, ED, KF, SG, FF, AN, EL, EI, AM, CT, B, I, M, S, RE, SS, NS, CA, HB, OI	68
„ *fluviatilis* Aubé	DF, KB, AY, LA, ED, SG, FF	17
„ *apicalis* Thoms.	DF, KB, AN	7
„ *immaculatus* Gerh.	KB, AY, LA, HD, ED, LL, KF, SG, PM, FF, EL, EI, M, SS	34
„ *wehnckei* Gerh.	DF, KB, WT, AY, RF, LA, PE, HD, ED, SG, PM, FF, BF, EL, EI, AM, I, RE, SS, NS, CA, HB, OI	56

Species	Vice-Counties	P.C. of Occ.
Haliplus lineolatus Mannerh.	DF, KB, WT, AY, RF, LA, PE, SK, BW, HD, ED, KF, SG, PM, PN, FF, KI, AN, EL, EI, AM, B, RE, SS	58
„ *lineatocollis* Marsh.	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, LL, KF, SG, PC, PM, PN, FF, KI, AS, BF, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	93
Peltodytes caesus Dufts.	AY	2
Hygrobia hermanni Fab.	ED	2
Noterus clavicornis Deg. (larger sp.)	DF, KB, KF, S	10
„ *crassicornis* Müll.	KB, KF	5
Laccophilus hyalinus Deg.	DF	2
„ *minutus* L.	KB, WT, AY, LA, BW, HD, ED, KF, PC, B	24
Bidessus minutissimus Germ.	DF, KB, WT	7
Hyphydrus ovatus L.	DF, KB, WT, AY, SK, RX, ED, FF, B	22
Hygrotus versicolor Schall.	KB, RX, BW, ED	10
„ 5-*lineatus* Zett.	DF, KB, WT, BW, HD, SK, KF, PC, PN, AS, EI	27
„ *inaequalis* Fab.	DF, KB, WT, AY, RF, LA, BW, HD, ED, KF, PN, FF, KI, AS, AN, EL, EI, WI, AM, DN, B, CT, I, M, S, RE, NS, SS, CA, HB, OI	76
„ *confluens* Fab.	DF, KB, RF, SG	10
„ 9-*lineatus* Steph.	KB, WT, AY, RF, SG, PC, PM, PN, FF, KI, AS, EL, EI, AM, DN, B, CT, M, S, RW, RE, SS, NS, CA, OI	61
„ *impressopunctatus* Sch.	DF, KB	5
Deronectes latus Steph.	DF, KB, WT, RX, BW, SG, PC, BF, EL, EI, B, S, RE, SS	34
„ *assimilis* Payk.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, ED, LL, KF, SG, PC, PM, PN, FF, KI, EL, EI, WI, AM, B, M, S, RW, RE, SS, NS, CA, HB, OI	80
„ *canariensis* Bedel	HB	2
„ *depressus* Fab.	DF, KB, AY, RF, LA, PE, SK, RX, ED, KF, SG, PC, PM, PN, FF, AN, BF, EL, EI, AM, B, CT, I, M, S, RW, RE, SS, NS, CA, OI	76
„ 12-*pustulatus* Ol.	DF, KB, WT, AY, RF, LA, PE, SK, BW, HD, ED, KF, SG, PC, FF, KI, AS, EL, EI, WI, AM, CT, B, I, M, S, RE, SS, NS, CA, HB	76
„ *griseostriatus* Deg.	DF, KB, WT, LA, FF, AS, EL, EI, B, I, M, S, RW, RE, NS, CA, HB, OI, SI	46

Species	Vice-Counties	P.C. of Occ.
Oreodytes borealis Gyll.	DF, KB, WT, AY, RF, LA, PE, BW, ED, KF, SG, PM, FF, EL, EI, AM, S, RW, RE, SS, CA	51
„ *halensis* Fab.	KB, M, FF, SI	10
„ *rivalis* Gyll.	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, KF, SG, PC, PM, PN, FF, KI, AS, EL, EI, I, M, S, RE, SS, NS, CA, OI	70
„ *septentrionalis* Gyll.	DF, KB, WT, AY, RF, LA, PE, RX, BW, ED, KF, PC, PM, FF, KI, AS, BF, EL, EI, AM, DN, CT, I, M, S, RE, SS, NS, CA, OI	73
Hydroporus pictus Fab.	DF, KB, WT, AY, RF, LA, BW, ED, KF, EI, WI, AM, RE	32
„ *granularis* L.	KB, WT, RF	7
„ *lepidus* Ol.	DF, KB, WT, AY, RF, LA, BW, HD, ED, KF, SG, FF, AS, AM, DN, B, CT, I, M, S, RE	51
„ *lineatus* Fab.	DF, KB, RX, BW, KF, FF	15
„ *neglectus* Schaum	KB	2
„ *tristis* Payk.	DF, KB, WT, AY, RF, LA, PE, BW, ED, KF, SG, PC, PM, PN, FF, AS, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	80
„ *umbrosus* Gyll.	DF, KB, WT, RF, LA, PE, HD, ED, SG, PC, PM, FF, KI, AS, AN, EL, EI, AM, DN, B, M, RW, RE, SS, NS, CA, SI	63
„ *angustatus* Sturm	DF, KB, WT, LA, BW, HD, ED, PC, PM, FF, EI, AM	20
„ *gyllenhalii* Schiod.	DF, KB, WT, AY, RF, LA, PE, ED, KF, SG, PM, FF, AN, EL, EI, WI, AM, CT, B, I, M, S, WR. ER, SS, NS, CA, HB, OI, SI	76
„ *dorsalis* Fab.	DF, CT	5
„ *morio* Dej.	DF, KB, WT, AY, RF, LA, PE, SK, ED, KF, SG, PM, PN, FF, KI, BF, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, NS, HB, OI, SI	76
„ *striola* Er.	DF, KB, WT, AY, RF, LA, PE, HD, ED, KF, SG, PC, PM, FF, AN, EL, EI, WI, AM, DN, B, M, S, RE, SS, NS, CA, OI	68
„ *palustris* L.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, HD, ED, LL, KF, SG, PC, PM, PN, FF, KI, AS, AN, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	97

Species	Vice-Counties	P.C. of Occ.
Hydroporus incognitus Sharp	DF, KB, WT, AY, RF, LA, PE, ED, KF, SG, PC, EL, EI, AM, CT, B, I, S, NS, HB, OI	51
„ *erythrocephalus* L.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, HD, ED, LL, KF, SG, PC, PM, PN, FF, KI, AS, AN, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	97
„ *rufifrons* Dufts.	DF, KB, RF, BW, PC, S, RE	17
„ *longulus* Muls.	DF, KB, AY, PE, ED, KF, PN, FF, AS, BF, EL, EI, DN, B, S, RE, HB, SI	44
„ *longicornis* Sharp	AY?, ED, PM	5
„ *melanarius* Sturm	DF, KB, WT, AY, RF, LA, PE, ED, KF, PM, PN, EL, EI, AM, DN, B, I, M, S, RE, SS, NS, CA, HB	58
„ *memnonius* Nic.	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, KF, SG, PC, PM, FF, AS, EL, EI, WI, DN, B, I, M, S, RE, SS, CA, HB, OI, SI	78
„ *obscurus* Sturm	DF, KB, WT, AY, RF, LA, HD, ED, KF, SG, PC, PM, FF, AS, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	78
„ *nigrita* Fab.	KB, WT, AY, RF, LA, PE, BW, ED, KF, SG, PC, PM, PN, FF, AS, EL, EI, WI, AM, DN, CT, B, M, S, RW, RE, SS, NS, CA, HB, OI, SI	78
„ *discretus* Fairm.	KB, WT, AY, RF, LA, PE, BW, ED, KF, PM, FF, AS, EI, B, I, M, S, RE, NS, CA, HB, OI	54
„ *pubescens* Gyll.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, HD, ED, KF, SG, PC, PM, PN, FF, KI, AS, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	93
„ *planus* Fab.	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, KF, PC, PM, FF, KI, AS, EL, EI, WI, AM, B, I, M, S, RE, SS, CA	68
„ *tessellatus* Drap.	DF, KB, RF, BW, ED, KF, PC, AM, DN, CT, B, I, M, S, RW, HB	39
„ *ferrugineus* Steph.	DF, AY, RF, LA, BW, ED, LL, KF, SG, AS, BF, EL, EI, AM, B, M	39
„ *obsoletus* Aubé	DF, KB, AY, [illegible], PE, ED, KF, EI, B, I, [illegible]	27

Species	Vice-Counties	P.C. of Occ.
Hydroporus foveolatus Heer	S	2
Laccornis oblongus Steph.	PE	2
Agabus guttatus Payk.	DF, KB, RF, LA, PE, BW, HD, ED, KF, SG, PC, PM, FF, AS, BF, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, NS, CA, HB, OI, SI	76
" *biguttatus* Ol.	KB, RF, LA, BW, ED, SG, PN, AS, BF, EL, B, S	29
" *paludosus* Fab.	DF, KB, WT, AY, RF, LA, PE, SK, BW, ED, KF, PM, FF, AS, EL, EI, B, I, M, RW, RE, SS, CA, HB	58
" *uliginosus* L.	DF, KB, BW, ED, AS, RE	17
" *affinis* Payk.	DF, KB, WT, AY, RF, LA, PE, BW, ED, KF, SG, PC, PM, FF, AN, EL, EI, DN, I, RW, RE, SS	54
" *unguicularis* Thoms.	DF, KB, LA, PE, HD, ED, KF, SG, PC, FF, EI	27
" *didymus* Ol.	BW	2
" *congener* Thunb.	DF, KB, WT, RF, LA, PE, ED, PM, PN, FF, KI, AS, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, SS, NS, HB, OI	66
" *nebulosus* Forst.	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, LL, KF, PM, FF, AS, EL, DN, M, S, RW, RE, CA, HB, OI, SI	63
" *conspersus* Marsh.	DF, KB, ED	7
" *labiatus* Brahm	DF, KB, WT, RF, LA, SK, RX, BW, KF, SG, KI, EL, EI, RE, SS	37
" *arcticus* Payk.	DF, KB, AY, RF, LA, ED, LL, KF, SG, PC, PM, PN, FF, KI, AS, EL, EI, WI, AM, CT, B, I, M, S, RW, RE, NS, CA, HB, OI	73
" *sturmii* Gyll.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, HD, ED, LL, KF, SG, PM, FF, AS, NS, EL, EI, WI, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI	85
" *melanocornis* Zimm.	DF, KB, WT, PE, RX, SG, PM, PN, EI, DN, B, I, M, S, RE, SS, NS, CA, HB, OI, SI	51
" *melanarius* Aubé	OI	2
" *bipustulatus* L.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, HD, ED, KF, SG, PC, PM, FF, KI, AS, AN, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	90

Species	Vice-Counties	P.C. of Occ.
Platambus maculatus L.	DF, KB, AY, RF, LA, PE, SK, RX, BW, HD, ED, KF, SG, PC, PM, PN, FF, AS, EI, AM, DN, S, RW, RE, SS, CA, HB	66
Ilybius fuliginosus Fab.	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, LL, KF, SG, PC, PM, FF, KI, AS, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	88
„ *subaeneus* Er.	DF, FF	5
„ *fenestratus* Fab.	KB, ED	5
„ *ater* Deg.	DF, KB, WT, AY, RF, LA, PE, RX, BW, ED, KF, SG, PC, FF, AS, NS, BF, EL, EI, RE, SS	51
„ *obscurus* Marsh.	RX, ED, AS	7
„ *guttiger* Gyll.	KB, RF, EI	7
„ *aenescens* Thoms.	DF, KB, WT, RF, LA, BW, ED, KF, PM, EL, EI, WI, DN, CT, B, I, M, S, RW, RE, SS, NS, HB, OI	58
Copelatus agilis Fab.	DF	2
Rantus exsoletus Forst.	DF, KB, WT, AY, RF, LA, PE, SK, BW, HD, ED, KF, SG, PM, PN, FF, AN, EL, EI, B, N, S, RW, RE, CA, HB	63
„ *pulverosus* Steph.	DF, KB, FF	7
„ *notatus* Berg.	AY, KF, SG, PC, FF, AS, SI	17
„ *bistriatus* Berg.	DF, KB, WT, AY, RF, LA, BW, ED, LL, KF, SG, PM, FF, EL, EI, WI, AM, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	73
Colymbetes fuscus L.	DF, KB, WT, AY, RF, LA, PE, BW, HD, ED, LL, KF, FF, AS, EI, B, I, M, S, SS, NS, CA, HB, OI, SI	61
Dytiscus semisulcatus Müll.	DF, KB, WT, AY, RF, LA, PE, SK, BW, ED, LL, KF, PM, AS, EI, AM, DN, B, I, M, S, RE, SS, NS, CA, HB, OI, SI	68
„ *marginalis* L.	DF, KB, WT, RF, LA, PE, SK, RX, BW, HD, ED, KF, PM, FF, AS, AN, EL, EI, DN, B, I, M, S, RE, SS, NS, CA, HB	68
„ *circumflexus* Fab.	ED	2
„ *lapponicus* Gyll.	PM, EL, EI, WI, B, I, M, S, NS, HB, OI	27
Acilius sulcatus L.	DF, KB, WT, AY, RF, LA, PE, BW, ED, LL, KF, PC, FF, AS, AN, EL, EI, WI, DN, B, I, M, S, RW, SS, NS, CA, HB, OI	70

Species	Vice-Counties	P.C. of Occ.
Acilius canaliculatus Nic.	DF, KB, RF, LA, BW, ED, KF, SG, FF, BF, EL, EI	29
Aulonogyrus striatus Fab.	S, HB	5
Gyrinus minutus Fab.	DF, KB, WT, AY, RF, RX, BW, ED, KF, SG, PC, AS, EL, EI, WI, AM, CT, B, I, M, S, RW, RE, SS, NS	61
„ *urinator* Ill.	HB	2
„ *caspius* Mén.	DF, KB, AY, LA, BW, KF, AN, EL, AM, DN, I, S, RE, HB	34
„ *colymbus* Er.	KB	2
„ *natator* Scop.	DF, KB, WT, AY, RF, LA, PE, BW, HD, ED, LL, KF, SG, PC, PM, FF, AS, AN, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	88
„ *suffriani* Scriba	KB	2
„ *marinus* Gyll.	DF, KB, WT, RF, LA, PE, RX, ED, LL, KF, SG, PN, FF, AS, EL, EI, AM, M, NS, HB	49
„ *aeratus* Steph.	DF, KB, WT, RF, SG, PM, AS, EI, CT, B, I, M, S, NS, HB,	37
„ *opacus* Sahlb.	PM, FF, AS, EL, EI, RW, NS, HB	19
Orectochilus villosus Müll.	DF, KB, WT, AY, RF, LA, RX, BW, PN, EL, EI, M, RW, RE	34
Hydrobius fuscipes L.	DF, KB, WT, AY, RF, LA, PE, SK, RX, BW, ED, KF, SG, PM, FF, AS, AN, EL, EI, AM, DN, CT, B, I, M, S, SS, NS, CA, HB, OI	76
Enochrus testaceus Fab.	KB, PC	5
„ 4-*punctatus* Herbst	S, CA, HB	7
„ *fuscipennis* Thoms.	DF, KB, WT, AY, PE, ED, KF, PM, FF, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	66
„ *ochropterus* Marsh.	DF, KB, LA, BW, ED, KF, PN, FF, EI, RE	24
„ *affinis* Thunb.	DF, KB, WT, AY, RF, LA, ED, PC, PM, FF, AN, EL, EI, AM, DN, B, I, M, S, RW, RE, SS, NS	56
„ *coarctatus* Gredl.	DF, KB, WT, FF, B	12
Paracymus scutellaris Rosenh.	WI, AM, B, I, M, S, RW, HB	19
Anacaena globulus Payk.	DF, KB, WT, AY, RF, LA, PE, SK, RX, HD, ED, KF, SG, PM, FF, KI, AS, AN, BF, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	90
„ *limbata* Fab.	DF, KB, WT, AY, RF, LA, RX, BW, KF, PM, FF, AN, EL, EI, AM, DN, CT, B, M, S, SS, NS, CA, HB, SI	61

Species	Vice-Counties	P.C. of Occ.
Helochares lividus Forst.	DF, KB, WY, ED, PM	12
Laccobius striatulus Fab.	DF, KB, WT, AY, LA, RX, FF, EL, B, HB, OI	27
„ *atrocephalus* Reitt.	KB, B, I	7
„ *alutaceus* Thoms.	DF, KB, WT, AY, RF, LA, PE, HD, ED, KF, PM, FF, AN, EL, EI, WI, AM, CT, B, I, M, S, RE, SS, CA, HB, SI	66
„ *purpurascens* Newb.	DF, KF, HB	7
„ *minutus* L.	DF, KB, WT, AY, RF, PE, BW, KF, PC, PM, FF, AS, AN, EL, EI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI	70
„ *biguttatus* Gerh.	KB, AY, RF, BW, ED, KF, SG, FF, EI, AM, B, S	29
Berosus luridus L.	KB, BW, RE	5
Limnebius truncatellus Thunb.	DF, KB, WT, AY, RF, LA, PE, BW, ED, KF, SG, PC, PM, FF, BF, EL, EI, WI, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	76
„ *nitidus* Marsh.	DF, BW, ED, KF	10
Chaetarthria seminulum Herbst	DF, KB, AY, RF, BW, ED, PC, EL, EI, B, S, SS, OI	32
Helophorus tuberculatus Gyll.	DF, LA	5
„ *rufipes* Bosc.	DF, BW, HD, ED, AS, EI, OI	15
„ *porculus* Bedel	DF, LA, HD, ED, KF, EL, EI, CT, RE, SS, NS, CA	29
„ *alternans* Steph.	KB	2
„ *aquaticus* L.	DF, KB, WT, AY, RF, LA, PE, RX, BW, ED, KF, SG, PC, FF, KI, AS, EL, EI, DN, RE, SS, NS, CA, HB, OI, SI ...	63
„ *flavipes* Fab.	DF, KB, WT, AY, RF, LA, PE, HD, ED, KF, SG, PM, FF, AS, EL, EI, WI, AM, DN, CT, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	78
„ *strigifrons* Thoms.	KB, RF, LA, B, RE, SS	15
„ *mulsanti* Rye	DF, KB, KF, EL, SI	12
„ *minutus* Fab.	KB, WT, AY, RF LA, BW, HD, ED, KF, FF, EI, DN, B, I, M, SS, NS, OI, SI	46
„ *granularis* L.	DF, KB, BW, ED, EI, CT, B, I, SS, NS, OI, SI	29
„ *brevipalpis* Bedel	DF, KB, WT, AY, RF, LA, PE, RX, BW, HD, ED, LL, KF, SG, PC, PM, PN, FF, AN, EL, EI, AM, DN, B, I, M, S, RW, RE, SS, NS, CA, HB, OI, SI	85
„ *arvernicus* Muls.	DF, KB, WT, AY, RF, LA, PE, BW, ED, PM, BF, EL, EI, B	34
Hydrochus brevis Herbst	DF, KB, WT, RF, BW, ED, PM, EI	19

Species	Vice-Counties	P.C. of Occ.
Hydrochus elongatus Schall.	DF, ED	5
„ *angustatus* Germ.	KB, RF, LA, BW, ED	12
Ochthebius exsculptus Germ.	DF, KB, AY, LA, PE, RX, BW, ED, LL, KF, SG, PC, FF, AS, EL, OI	39
„ *marinus* Payk.	DF, KB, HD, AN	10
„ *bicolon* Germ.	KB, LA, PE, EL	10
„ *impressicollis* Cast.	DF, KB, AY, ED, KF, FF, EL, CT, I, M, S, RE, CA, HB, OI	37
„ *auriculatus* Rey	DF, KB, KF, EL	10
„ *lenensis* Popp.	EL, EI, RE	7
„ *minimus* Fab.	DF, KB, LA, BW, HD, KF, FF, EL, EI, M, RE, SS, CA, OI	34
„ *punctatus* Steph.	M, HB	5
„ *lejolisii* Rey and Muls.	KB, AY, BW, KF, FF, EL, WI, AM, B, M, S, RE, HB	32
Hydraena testacea Curt.	KB, BW	?
„ *riparia* Kug.	DF, KB, WT, AY, RF, LA, PE, RX, BW, ED, KF, SG, PC, PM, FF, AS, BF, EL, EI, DN, B, CA	54
„ *nigrita* Germ.	DF, KB, AY, LA, RX, BW, KF, SG	19
„ *rufipes* Curt.	KB, LA, BW, KF, SG, FF, RE, OI	19
„ *gracilis* Germ.	DF, KB, AY, LA, PE, SK, RX, BW, SG, PC, PM, FF, AS, EL, EI, RW, RE, NS, HB	46
„ *minutissima* Steph.	DF, KB, PE, BW, KF, EL, RE	17
„ *pygmaea* Wat.	PE, PM, BF, EL, B	12
„ *pulchella* Germ.	DF, KB, KF, EL	10
„ *britteni* Joy	KB, WT, AY, RF, PE, BW, EL, EI, B, SS, OI	27

I have included in the above list four species which, although they have been recorded from Scotland are usually regarded by later authors as having been either wrongly identified or included by mistake, and I give particulars about them here in case evidence comes to hand concerning them.

III—DOUBTFUL SCOTTISH SPECIES

1. **Oreodytes halensis** has been recorded from four Scottish counties, Dumfries (Little, 1853), Angus (Hislop, 1854—he gives *griseostriatus* as a synonym), Mull (Clark and Hislop—five specimens as a result of three days' hard work in a deep highland loch, 1854), and Shetland, where it was found by Squire in 1858 and exhibited before the Entomological Society. It will be noticed that all these records date back to the 1850s, when little was known as to the distinctions between *halensis, D. griseostriatus* and *D. assimilis.* Stephens (1828) recorded *areolatus* Dufts., which is apparently generally accepted as a synonym of *halensis,* but it has also been stated that Stephens' *areolatus* is *assimilis.* However, Stephens' *frater,*

of which he gives a figure, is undoubtedly the latter species, and his description of *areolatus,* with the margined sides of the thorax, in which it differs from *frater,* is a distinction between *halensis* and *assimilis*! I only mention these points as showing confusion.

A scrutiny of the British distribution of *halensis* shows that its centre is in the eastern counties of England from Essex to Lincs., and the outlying records are for Salop (1828), South Lancs. (1906), Cumberland (1828), and Mid-West Yorks. (1942). The early records are open to doubt like the Scottish ones, but the 1942 record is by W. D. Hincks, who sent me the specimen he took at Askham Bog. This was obviously an individual exploring possibilities northwards so that at least some of the others may have been similar explorations.

2. **Hydroporus dorsalis** is a definitely 'English' species recorded from most counties in that country but absent from the extreme south-west, from Wales except Glamorgan, and from Westmorland and Cumberland, and yet recorded from Dumfries 'Raehills' by Little, as stated by A. Murray (1853). Hamlet Clark (1855) stated that he had 'taken it freely in Norfolk and Huntingdonshire; also Cambridge Fens, Cantire, near London'. The correctness of both these Scottish records is doubtful for several reasons. Not a few collectors have failed to distinguish *dorsalis* from *Deronectes latus.* In June 1911, when I was living in Norfolk, I made my first serious search for water beetles in Scotland in Inverness-shire, and in a gravelly burn near Aviemore I took a beetle which I recorded in my notebook as *dorsalis.* As this species was common in East Anglia, and as I knew nothing about its northern distribution, I dropped the specimen into the burn. It was not until some time later when I made the acquaintance of *latus* that I began to doubt my record of *dorsalis.* I am not the only coleopterist who has made this mistake concerning these two species, and even in a museum I have seen a specimen of *latus* labelled '*dorsalis*'. Donisthorpe confused the two when he recorded having taken *latus* at Hanwell, Middlesex 'in a stagnant pond' (1904), and in his notebook, now in the British Museum (Natural History), he has recorded taking it in a stagnant pond in South Hants.

I think it is reasonable to regard these two ancient Scottish records of *dorsalis* as referring to *latus,* and I think it is doubtful whether *dorsalis* has ever occurred in Scotland.

3. **Hydroporus neglectus** is a species described as inhabiting north and middle Europe, and yet its British centre is in south-east England. This suggests that it is a comparatively recent arrival. In outlying counties it has been recorded from Staffs. by Fowler (1887), who mentions Cannock Chase, but Tomlin, in the Victoria County History list (1908), omits the record. It was found in Askham Bog, York, in 1872, by H. Hutchinson, who stated that it was first discovered there by Power, although there is no such specimen in the

Power collection: and W. J. Fordham did not include Power's record in the list of Yorkshire water beetles he sent me in 1931. Hutchinson also found about 50 specimens on Stockton Common, North-East Yorks. It was taken again at Askham Bog by W. C. Hey in 1894, who described is at 'exceedingly scarce, only one specimen'. And this seems to have been the last record for the species in Yorks. in spite of the number of collectors who have worked various places in the county during the last 60 years.

This shows that *neglectus* is at its extreme northern range in Yorks. But several species which do not occur in English counties north of Yorks. have been recorded in Scotland, so that need not throw doubt upon the record of W. Lennon (1895) for one specimen taken in Lochrutton Loch, Kirkcudbright. However, the fact that only one specimen was mentioned, and also the fact that there is no specimen in the Lennon collection in the Royal Scottish Museum, Edinburgh, makes the record very doubtful.

4. **Berosus spinosus** was included by W. Lennon (1876) in a short paper in the Transactions of the local society (34), where he described it as 'only in salt marsh opposite Caerlaverock Castle; not common even there'. As, however, in the same paper he recorded *Agabus brunneus* as 'rare: Kelton in flood refuse only'—the *Agabus* being only known from four south of England counties—the probability is that the *Berosus* was wrongly identified, especially as there is no specimen in his collection in the Royal Scottish Museum. However, there is no other *Berosus* which could have been the insect taken and mistaken for *spinosus*. The fact that, somewhere about 1860-1870, R. Lawson recorded taking the species at Scarborough does suggest that the species had made an attempt to extend its range, again assuming that Lawson's identification was correct.

I leave the species as doubtfully Scottish.

In addition to these four there are some species whose presence in out of the way places makes explanation difficult, but the specimens are in existence and the records must therefore be accepted.

IV—SPECIES WHICH HAVE DISAPPEARED RECENTLY

1. **Hygrotus versicolor.** The identity of this species in early records is not easy because the name *reticulatus* under which it was once known has been used also for the common *inaequalis*, and *quinquelineatus* is a species of the same size and closely resembling *versicolor*. *H. versicolor* has been recorded from four Scottish counties, Roxburgh (1832), as *H. collaris*, 'stagnant waters throughout Roxburgh, not infrequent'; Edinburgh (1832), and there is a M'Nab specimen, labelled 1864, 'Botanic Gardens, Edinburgh', in the Dublin Museum; and Berwick, as *reticulatus*, A. Murray (1853), who also gave the Roxburgh record.

There was no other Scottish record until I found the species in some numbers, including soft, newly emerged individuals, in Sep-

tember 1907 in the River Dee at Threave Bridge, Kirkcudbright. I have 11 specimens in my collection from that one spot, where it has been searched for since but without result.

The gap of about 60 years between the records suggests that there have been two separate invasions from the south.

For the 1878 meeting of the British Association in Dublin, M'Nab, who was Professor of Botany at the Royal College of Science there, produced a list of the coleoptera of the district which included *H. reticulatus*. There are records for the Dublin Canal (Hogan, 1853) and the River Flesk, Killarney (Wollaston, 1847), but how far these refer correctly to *versicolor* is uncertain. The most northern Irish record is one by Haliday for *reticulatus* for 'near Belfast', and as Haliday died in 1870 at the age of 71, his list probably dated between 1850 and 1860. It is significant that neither Johnson nor Halbert nor any subsequent collector ever took the species, so that it looks as if there was one Irish invasion far back in last century which has died out.

2. **Helochares lividus.** In 1869 Sharp described *Philhydrus punctatus* as a distinct species from *P. lividus*, but it was not until 1871 that he recorded *punctatus* as 'rather common on Moncrieff Hill, Perth', the first record for *lividus* in Scotland of which we now recognize *punctatus* as an habitat form. The next Scottish record was published in 1903 by W. Evans, when he stated that he had taken one specimen on Bavelaw Moss, Edinburgh, in June, 1899. In 1903 J. G. Gordon recorded having taken a single specimen on the Wigtown moors, but as he also claimed that he had taken *Philydrus maritimus* on the same moors—a brackish water species so far not known in Scotland—the *punctatus* record is perhaps doubtful.

In 1906 I found several specimens on the Lochar Moss, Dumfries, in June, and in July I found one specimen on the Kirkconnell Moss, Kirkcudbright; but I did not see the species again until August, 1909, when it occurred in some numbers in a large pond with *sphagnum* edges behind Rockliffe, Kirkcudbright. I again found it there in July and August, 1910. That seems to be the last Scottish record for the species. All the records may indicate the gradual disappearance of one invasion, or the Perth record may have been the result of one invasion and the Solway records of another.

The temporary success of these two species as Scottish residents may show what has happened in a number of cases, and there may be other species which will disappear in due course. But there are a large number which appear to have become established and a number which appear to be just making an attempt to become inhabitants.

My records indicate from how many Scottish divisions each species has been recorded, and for purposes of comparison I have converted

these numbers into percentages. The first revelation from these results is how very few of our species have occurred in more than 80 per cent of the divisions. There are two at 83 per cent, two at 85 per cent, three at 90 per cent, two at 93 per cent, and two at 98 per cent. At the other extreme there are 56 species in less than 7 per cent of the divisions and 86 species, that is 51 per cent, each occupying not more than 15 per cent of the divisions.

The distribution maps show (1) that the majority of these are definitely more abundant in the southern half of England; (2) that the majority of these are southern species on the Continent, from Mid-Europe to the Mediterranean and North Africa, some even including the Atlantic Islands.

V—EXAMPLES OF SPECIES WHICH APPARENTLY REACHED SCOTLAND BY THE SOUTHERN ROUTE

Maps 1-4 show the range of four North-European species so sparsely distributed in Scotland that it seems reasonable to assume that they reached that country by way of England. Maps 5-8 show the range of four South-European species, which show somewhat similar ranges to those in maps 1-4 and thus support the view that the four northern species came by the same route into Britain.

DISTRIBUTION MAPS 1-4

1. **Agabus uliginosus** Steph. 2. **Hydrochus elongatus** Schall.

Two North European species which have arrived via the south-east coast route.

3. **Laccornis oblongus** Steph. 4. **Agabus melanarius** Aubé.
Two North European species, each with only one Scottish record. Possibly some or all the records are of chance and independent arrivals.
● *Specimens taken personally or seen in other collections.*
× *Records from other sources.*

1. **Hygrotus confluens** (10%). Map 5. A South European species which has established itself in most of the English divisions up to Cumberland and South Northumberland but has only eight Irish division records all south and east of the line from North Kerry to Co. Down. There are Scottish records, one for Renfrew dating 1853 'near Paisley', A. Murray, and another for Stirling, 1853, 'near Falkirk, by the same author, apparently indicating an early invasion and a temporary colony. For 90 years there was no further record, but in 1946 my son discovered it in a muddy pond, almost without vegetation, just above the level of the Caerlaverock marshes, a pond in which, during the summer, the cattle frequently cool themselves. Not until 1948 did we find the species elsewhere and then only a single specimen was taken on the Southwick merse and one on Kirkconnell merse, on the opposite side of the Nith from Caerlaverock.

It seems therefore as if there has been a recent attempt to move into Scotland. In this connection the Cumberland records are of interest. The first published seems to have been in 1911, when F. H. Day included it in a list of the Coleoptera of the county. He had however sent me the record in a list in 1906, and it was

H. Britten who found the species in 'streams, etc., Great Salkeld and Anthorn'. J. Murray next found it in 1927 'in a large shallow pool on the sandhills near Sellafield station; a partly brackish pool just above the beach'. In the southern half of England where it is common it is frequently in clay ponds, but in the north where these ponds are less common it seems to occur mostly in brackish water or in water where at least some salt from the sea reaches. The only clay ponds I know in Cumberland are an old clay pit near Maryport, where, in 1937, in two or three dips of the net I captured several specimens.

I attribute these Dumfries and Kirkcudbright specimens to an advance from Cumberland of a definitely south European species.

2. **Agabus didymus** (2%). Map 6. This species, common in the Mediterranean Islands and in North Africa, has succeeded in occupying most of England, and there are records for Durham and Northumberland. The Berwick record, S. W. Miller (1939), is for two specimens taken almost at the mouth of a small stream at Coldingham, and this seems to have been an unsuccessful attempt to found a colony in Scotland.

3. **Helophorus alternans** Stephens, 1835: Gené, 1836: *intermedius* Muls. (1844) (2%). Map 7. This species, known to many early British coleopterists as *intermedius,* has since been generally accepted as Gené's species by priority. It was not until I got interested in the species for this paper that I began to make enquiries as to whether Bakewell had published the name as, if so, it would be his species. Then it occurred to me that, in the absence of any paper by Bakewell, the species belonged to Stephens, as he had made the prior publication. I asked my son if there was any Bakewell publication or any Bakewell specimen in the Stephens collection, and, having failed to find either the one or the other, he wrote and made the same point that I had reached about the ownership of the name.

I even doubt if Gené was describing the same species. He gives the length of his *alternans* as $1\frac{1}{4}$ lines, whereas our species is nearer 3 lines. The size would suit *nubilus,* but in both these species the raised striae extend almost to the apices of the elytra, although by changing the angle of the light it is possible to obscure parts of the striae towards the apices in both species.

In this country this insect is almost if not entirely confined to brackish water, but the inland records, e.g. Notts. and Mid-West Yorks. are obviously for fresh water habitats. Mulsant described it as 'common in France in small streams throughout southern Europe'. The Yorks. record was given me by W. J. Fordham as from W. D. Roebuck, who reported it from Roecliffe on the River Ure, near Boroughbridge, at least 40 miles from the coast, and Nottingham is about 25 miles from the nearest corner of the Wash. As I have received small specimens of *H. aquaticus* with the name *intermedius*

I incline to the view that such specimens from these two inland localities have produced these records. Of course it is always possible that wandering individuals have been found.

If we omit the Yorks. record, the most northerly area in which the species has been found in England is South Lancs., where it was abundant in shallow brackish pools in 1862 and 1863 when it was found in the area between Liverpool and Formby by F. Archer and by G. R. Crotch, and there is a Crotch specimen in the Sharp collection labelled 'Liverpool'. My son found a single specimen in a brackish pool at Southwick, Kirkcudbright in August, 1948. I have worked the long stretches of brackish pools along that coast at intervals since 1907, and it is here the crustacean *Apus cancriformis* has been found on two or three widely separated occasions, but I have never seen *H. alternans* there until this specimen turned up. The only Irish record is one by C. W. Buckle, who found it on the marshes at Culmore at the mouth of the River Foyle, Derry, in or about 1899, and that is a typical brackish water habitat. Although I have not visited these marshes I have worked at least some of the few merselands between the south of Co. Down, where *Haliplus apicalis* flourished, and the extensive area near Limavady, within ten miles of Culmore, without meeting with this species, so that I assume that the only known Irish colony was a temporary one like that in South Lancs.

4. **Ochthebius punctatus** (5%). Map 8. The known Scottish range of this species is limited to the Mid-Ebudes and Outer Hebrides, and it was first found by me in Tiree in 1927. In 1936 it was found on Barra by A. R. Waterson, who found more than one specimen. It was certainly established on Tiree, as I found a number of specimens in some pools in the merse in Hynish Bay on the south side of the island and also in the tidal area of a burn flowing into the bay.

An interesting point about this species is its limitation in England to south of a line drawn from South Lancs. to East Suffolk, while its range in Ireland includes about half of the coastal counties. I have taken it in nine divisions and have seen it from North Kerry, and there are only nine other coastal counties, some north, some south, one east and some west, where it has not been found.

With this wide dispersal round Ireland, the limited Scottish range is peculiar. The species certainly does not occur in south-west Scotland, as not only I, but Sharp and Lennon and McGowan and others have exhaustively explored the extensive merse areas. I have worked the South and North Ebudes, especially the brackish water areas in Islay and Jura, without finding it, and I also worked the same type of habitat in the Orkneys with the same result.

Possibly further search for the species in suitable habitats round the rest of Ireland would complete the circle, but at any rate it looks as if the Western Isles had received this South European species

DISTRIBUTION MAPS 5-8

5. **Hygrotus confluens** Fab.

6. **Agabus didymus** Ol.

7. **Helophorus alternans** Steph.

8. **Ochthebius punctatus** Steph.

Four South European species which have arrived via the south-eastern route.

from that country. But the very mixed assembly of species of these western islands which do not occur on the western Irish coast, and whose Continental range varies from North Europe to the Mediterranean area, makes it useless at present to suggest how the species assembled there.

I have given only four examples of the group of which the maps 5 to 8 show the type of Britannic distribution, but the majority of our water beetles belong to this group, the number of occupied divisions being more numerous in the southern half of England. Although in some cases there may be another explanation to account for this, the explanation for the majority of these species seems to be that they arrived in our area via the south-eastern route and are in process of extending their ranges northwards.

VI—EXAMPLES OF SCOTTISH SPECIES WHICH APPARENTLY CAME IN FROM THE NORTH

Maps 9-12 show the ranges of four North-European species, mainly Scottish in their range, suggesting that they arrived from the north.

1. **Deronectes griseostriatus** (15%) (English 3%). Map 9. I have referred to this species in dealing with *O. halensis* (page 83), as either this species or *D. assimilis* was first recorded under that name from Dumfries (1853), from Mull, and from Angus (1854). Since then it has been found in a number of the Scottish divisions, but as it is always on somewhat high ground it is probably more common than the records suggest. It descends to lower levels in the extreme north and west. For instance, on Lewis I found it at about 250 feet, and it was also found on the small island of Fiaray, just north of Barra. In Caithness and the Orkneys I found it at not more than 500 feet, but in Easterness it was at 1,100 feet on one occasion and at 2,300 on another. From Wales I have seen a specimen from Llyn-y-Parc, Caernarvon, at about 800 feet, and one from Merioneth at 2,000 feet. There are four Irish divisions spaced round the coasts with records. Antrim at 1,075 feet, Achill Island at 850 feet, Wicklow, Kippure Mountains, height not known, and The Commeragh Mountains, Waterford, at 2,000 feet.

On the Continent this is mainly in the north, but it is found in the mountains of France, in the Alps and the Pyrenees, and it also occurs in North America, so that it has wandered over wide areas. Its Britannic range suggests that it first arrived during the glacial period and from the north.

2. **Hygrotus novemlineatus** (61%) (English 13%). Map 10. This species has penetrated England from Scotland and has records for five of the northern counties. Of the others, one is for Cheshire for 1908 and is the only one, repeated later in a list as from a 'shallow peaty pool in Delamere Forest'. The southern group of records are from North Hants, Berks and Dorset and begin in 1829, when Stephens recorded that G. T. Rudd had taken it in

DISTRIBUTION MAPS 9-12

9. Deronectes griseostriatus Deg. 10. **Hygrotus novemlineatus** Steph.

11. **Agabus arcticus** Payk. 12. **Helophorus arvernicus** Muls.

Four North European species which have arrived via the northern route.

flooded gravel pits at Weyhill. In 1855 Curtis and Dale found it in Woolmer Pond, which was then a gravelled bottom and clear water pool, but has now become filled up with sphagnum which in dry summers conceals the water. Nothing more was heard of the insect until 1908, when Tomlin discovered it in the puddles at the bottom of one of the large meres near Crowthorne, Berks, where it was one of the commonest species and continued freely for about two months. In 1917 W. E. Sharp again found it in one of the meres with a gravel bottom in the same neighbourhood, and in that year I saw a single matt female of the species which W. H. Haines had found near Winfrith, Dorset. These are all the records for this little group, which may have survived in that area for more than 80 years or which may have arrived more than once from elsewhere!

3. **Agabus arcticus** (73%) (English 13%). Map 11. Assuming that the Salop record is correct, there are ten records south of Scotland, one Welsh and nine English, it is almost entirely a mountain species in the Britannic area, so that I was surprised to find a specimen from Brinnington Marsh pits, Cheshire, which are, or were, in low ground, in a collection of water beetles sent me by J. R. Hardy in 1912. I assume therefore that it was an individual on passage to some more southerly habitat, which had dropped into the pits. Similarly Hope's record for Netley, Salop, which, so far as I know, cannot be verified, was for an individual also seeking a new habitat. Netley is also a low-lying area.

The distribution seems to indicate that there has been no recruiting via the south-eastern route, so that the species is British entirely as descended from the glacial invasion, or at any rate from the north.

4. **Helophorus arvernicus** (34%) (English 16%). Map 12. In this northern European insect there is no gap between northern and southern invasion contingents if there have been two invasions, and this is the difficulty with regard to establishing or suggesting on reasonable grounds whence some of the water beetles have reached this area. The absence of records north of Easterness and the fact that *arvernicus* does occur in France may encourage the view that it entered the country via the southern route. The fact that the English percentage is only half that of the Scottish may be accounted for by the absence of suitable habitats in East Anglia, but that seems doubtful, because in the north of England and in Scotland the species is frequently found along the edges of tidal waters on the mud, although possibly only because it gets washed down from the upper waters. The Irish occupation, confined to the north-east, does suggest a Scottish origin, but whether or not this is the explanation is a mere guess, although some support for it may be found by comparing the maps of other species already dealt with.

5. **Deronectes assimilis** (80%) (English 53%). This species occupies most of the Scottish divisions and most of the English

as far south as a line drawn from Monmouth through Bedford to East Suffolk, south of which there are only four county records. Berks. The only record is in the Victoria County History list, 1906, where 'Reading and Pangbourne' is given. Surrey. The only record is by Linnell (1867), for 'Reigate Heath'. Dorset. The only record is by A. Ford, quoted by E. J. Pearce in his Coleoptera of Dorset (1926). South Devon. The only record is by Leach for 'River Plym, near Plymouth', quoted by Stephens (1839). It will be noted that, not only is each county possessed of only one record, but all except that for Dorset are very old. Even Ford's record may date back into last century, as he was collecting about 1890-1895.

These records suggest either that *assimilis* at one time had succeeded in capturing the whole of England by invasion from the north—and as it is a northern Continental species that seems a reasonable explanation—or the species reached England via the south-east route, spread northwards to cover Scotland, but lost its hold on southern England.

6. **Hygrotus quinquelineatus** (27%) (English 17%). Except that it is less widely spread, this species shows the same type of distribution as the preceding one because, south of a line across the middle of England through Leicester, there are only three divisions from which it has been recorded: South Hants, Surrey and South Essex. In this case, however, *H. versicolor* is readily mistaken for *5-lineatus* and vice versa, so that many records may be wrong. The difficulties are increased by the fact that in certain parts both species occur together! For instance, in Notts., in the River Poulter at Normanton Bridge, Clumber, I took both species in the same haul of the net in September, 1937, and in the same month I took them both near Blaxton, close to the Lincs. border. Again at Haxey, N. Lincs., both species were in a large slow-flowing drain. I have mentioned this specially because of the South Hants record, which is for the New Forest and was by A. Thornley in 1930. I have seen the two specimens which are in the Nottingham Natural History Museum, and I suggest that there has been some confusion between specimens by which Notts. *quinquelineatus* have replaced New Forest *versicolor*! The Surrey record is in the Victoria County History list (1902) and there are no details; the South Essex record is for a specimen exhibited by Milton at a meeting of the City of London Entomological and Natural History Society in 1892, but although much work has since been done in Epping Forest, whence the specimen was said to have come, no subsequent author has recorded it. Of course it is always possible that these out of the way records may be due to chance wanderings.

In the north the usual habitat is in lochs, but farther south it inhabits large quarry pools, canals and rivers. One peculiarity of the Britannic distribution is its wide dispersal through Ireland, where

it has been recorded from 62 per cent of the divisions. I have already discussed *versicolor* (page 85) and I will repeat here what I said about these two species in 1940 (page 208). 'With regard to *versicolor* it might be reasonable to suggest that it is a post-glacial immigrant, which arrived by way of south-east England and is spreading northwards, but the odd distribution of *quinquelineatus* in England, its wide range in Ireland and its absence from the north and west of Scotland suggest that it was in this country long before *versicolor*.' At the time I wrote that I had not gone into details in this matter of the origin of our water beetles, but I was evidently on the right lines in 1940!

7. **Dytiscus lapponicus** (27%). This species is now known to occur, or to have occurred, in eleven Scottish divisions, and in one Irish one. It is found from about 800 feet above sea level upwards in its more southern localities and comes down to sea level in the Outer Hebrides and the Orkneys. There is only one record for West Donegal, where J. E. Somerville found it in 1868, well established in a small tarn on a mountain. There are no English or Welsh records and, except for Arran and Jura, there is no record south of Mid-Perth, where a single female was taken in April 1939 by T. T. Macan in a small lochan at about 2,000 feet above Glen Ogle. Of course the species may have died out in the English and Welsh mountains, but I think it possible that *lapponicus* reached Britain from Scandinavia either during or after the glacial period.

8. **Acilius canaliculatus** (29%) (English 7%). This is another species with few English records, but they are scattered—Yorks., Flint, Salop, South Hants and Surrey. When the records form two groups or sections, with a gap between them, as in some of the species already mentioned, the suggestion that there have been two separate invasions from north and south is plausible, but when the English records are scattered as in this case, a single invasion, either from the north or south would seem equally reasonable. If it came from the south it has spread northwards and has gradually faded out in southern England. The latest records for Surrey are 1867, while the latest for Cambridge (Whittlesea Mere being in that county and not in Hunts.) is 1824. The only record for Salop was by J. S. Clarke, Whixall Moss, 1949, and the only record for Flint was in 1939, when I took a female specimen on Fenn's Moss. When we come to South-West Yorks. we have a number of records indicating that the species is well established there, especially on Thorne Waste and as recently as 1953.

This is a common species in France as far south as the 46th parallel (Guignot), so that it could have reached Britain by the south-eastern route, and therefore the question is, are these southern records for invaders from the north or are they evidence of either the arrival in England of the species or of intermittent invasions?

9. **Gyrinus opacus** (20%). It has taken some time to sort out the British records of this species because, until recently, the common *aeratus* of Stephens has been regarded as a shining form of Sahlberg's species. As far as possible I have separated the records, and whereas *aeratus* ranges over England, Scotland and Ireland, *opacus* is only known at present in Scotland and not south of Mid-Perth, although it is quite likely that its range is wider than at present known. It is a difficult insect to find because, as soon as it is disturbed it either dives under the bank or into the peat at the bottom of the pool. It lives in shallow peat pools mostly at high levels and is usually in a mixed population with *natator*, and as this common species merely swims about when disturbed, the collector catches it and naturally assumes that it is the only species there.

The Continental range is given as Finland, Greenland, Iceland, Scandinavia, North Germany, North Russia and North Siberia, and so I regard it as probable that this is one of our water beetles which has reached Britain without coming through the south-east route.

10. **Ochthebius lenensis** (7%). This species seems to show definite evidence of post-glacial arrival in Scotland from the Continent. When I first discovered it on the salt marshes below Tain, Easter Ross, it was in only a few pools, but it was also in a shallow pond well above high water and near Tain station. That was in August, 1939. I visited the same pond in September, 1951, and the *Ochthebius* was still there, but in reduced numbers. In May, 1950, it was found in brackish pools at Kinloss, Elgin, by R. Richter, and in May, 1952, G. Leslie Frewin found it at Redcastle on the north side of the Beauly Firth in the same type of habitat.

This seems a clear case of recent immigration, as I have worked many salt marshes northwards and southwards of Tain without finding it, and I may add that, once seen, this species is not likely to be mistaken for any of our other species by anyone who knows anything about our Ochthebii.

The discovery of this species in what appears to be a very limited area supports my view that although many of our northern species may have descended from ancestors which arrived with the glacial period, arrivals from the north did not cease when the glacial period came to an end. Such arrivals might well be much less frequent than arrivals by the southern route, hence the fewness of our 'Scottish' species. It will be interesting to see whether *lenensis* survives and, if so, whether it extends its range.

VII—EXAMPLES OF SCOTTISH SPECIES WITH APPARENTLY TWO AREAS OF DISTRIBUTION

I have already mentioned in connection with some of these 'Scottish' species, e.g. *H. 9-lineatus, A. canaliculatus* (*antea,* pages 92 and 96), the possibility that the original invasion from the north has been followed by a post-glacial invasion via the south-eastern route,

and I give particulars here, and maps 13-16, of four species in which there is a gap between what appears to be the dispersal from the north and a limited area towards the south of England which may be a subsequent arrival of the species via the southern route. On previous occasions (16, 17, 18) I have suggested this with regard to one of these species, *P. scutellaris,* but now I give three others by way of support.

1. **Oreodytes borealis** (51%) (English 31%). Map 13. This insect has appeared as two species under names *borealis* and *davisii,* and has also been confused with *O. halensis* and, I believe, that one of the earliest records for *borealis* (Hamlet Clark, 1855, 'not uncommon in running water', Cambridge) was for *halensis.* Imms, 1938, credits me with finding *borealis* in that county, but it was certainly not in the list with which I supplied him, although Clark's record was. Clark was also responsible for recording *davisii* from 'near Norwich in a small gravelly brook, May, 1854', and in 1858 Leeds Fox and W. Gardner recorded *davisii* as occasional near Bungay, East Suffolk, these records being omitted by J. Edwards, 1893, who recorded *halensis.* This last-named species was in East Norfolk but *borealis* was not. The South Hants record by E. Moncreaff, 1840-1880, is also I believe due to misidentification.

I have seen specimens of *borealis* from North-East Yorks., Mid-West Yorks., Salop and Glamorgan, and if we draw a line across the country through these divisions we get the southern limit of range of the species, whereas north of that line most of the divisions have records of it. The Irish records run round the coast from Donegal east via Derry and Antrim to Wicklow.

As this is one of the northern species on the Continent, I incline to the view that it belongs to the small group which originally arrived in Britain during the glacial period.

2. **Agabus congener** (66%) (English 7%). Map 14. This species may from time to time have been confused with either *sturmii* or, according to Sharp, with *uliginosus,* but, except for one English and four Scottish divisions, I have seen *congener* from all the divisions from which I have records. The interest in this species lies in the very suggestive small group of south-eastern English records, West Kent, Oxford and South Hants and the wide spread Scottish range. The single Irish record from the Mweelrea mountains, West Mayo, where I found one specimen in March, 1910, at about 950 feet above sea level at least indicates that the insect can travel.

3. **Ilybius subaeneus** (5%) (English 26%). Map 15. The history of this species in Britain is illuminating. It was first discovered somewhere near London about 1839 and gradually worked its way northwards, Suffolk 1887, West Norfolk 1890, East Norfolk 1893, Cambridge 1904, North Lincs. 1908, Isle of Man 1910, Angus 1933, Dumfries 1945, with other records interspaced. There is no doubt

DISTRIBUTION MAPS 13-16

13. **Oreodytes borealis** Gyll.

14. **Agabus congener** Thunb.

15. **Ilybius subaeneus** Er.

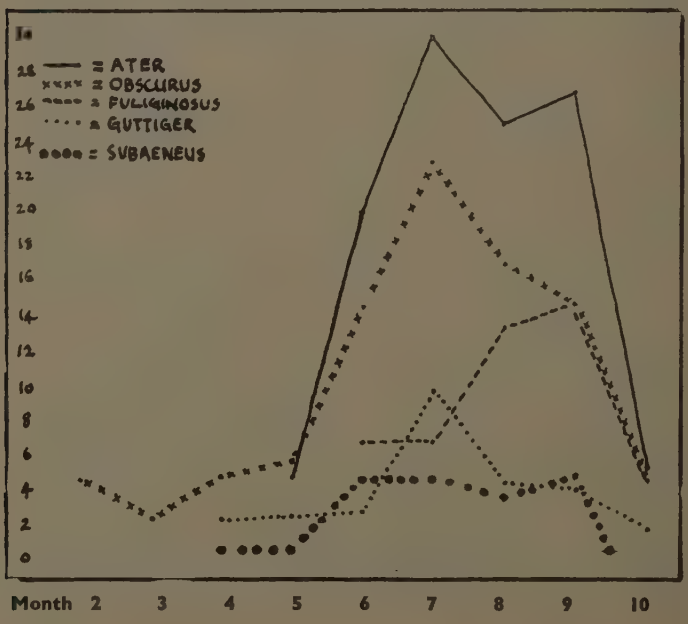
16. **Paracymus scutellaris** Rosenh.

Four species in which a gap between northern and southern groups suggests the possibility that there have been two invasions: one from the north followed by one from the south.

but that the species arrived in the south and has moved steadily northwards, taking about one hundred years from the first appearance to the most northerly one.

On the other hand it is possible that the Angus colony was the result of a more recent arrival from the north and, if so, this species is a case similar to that of *Ochthebius lenensis* already mentioned.

Its appearance in East Norfolk during my assiduous working of the Broads district, although it had been found in the vice-county the year before, is of interest. I commenced serious work in 1904, and in that year I worked the pond in Hickling village several times. I did the same in 1905, but it was not until September that I found the first specimen. I found another in October. In 1906 I found two in July, August and September, so that, in spite of the fact that I had been removing my captures, it seemed to have become established. I have included a chart showing the periods of activity



Five species of *Ilybius* during 1904 in East Norfolk (Norfolk Broads District) in the 1,037 collections made during nine months. All my 22 dated records for *subaeneus* indicate the same period of activity for that species as for the others.

of each of four species of the genus during 1904 and all the dated records I have for *subaeneus* for the whole country, and these show that the periods of activity of all the species of the genus are the same.

4. **Paracymus scutellaris** (20%) (English 13%). Map 16. In the case of this species the gap between the two distribution sections is very marked and, but for the little collecting that has been done in Donegal, we might have had a more or less complete series of occurrences from the Outer Hebrides to Kerry.

The species is fairly common in spots in southern England, but I have more records from South Hants and South Devon than from any other English county. In the New Forest it is to be found in many of the pools on the open ground, and it is also widely spread along the southern parts of South Devon. During my years in Somerset I found it only in one spot, a mossy seepage bank with a small pool on the moorlands about Priddy, and it was there on the several occasions I visited the place from August, 1927, to March, 1932. Similarly in Sussex I found it only in one mossy swamp at the edge of some brick pits, and it was in some numbers there from July, 1937, to April, 1939. On the Scillies my record is the only one and it was for one specimen. In 1915 I found a single specimen on high ground in a peaty pool near Capel Curig, Caernarvon, and in 1931 I found several specimens in Cardigan in a peaty bog near Porth. In 1909 F. Bouskell sent me a list of Leicester water beetles and this included the *Paracymus* 'Leicestershire, H. W. Bates'. I have Bate's Bradgate Park list, 1895, but it is not in that and so is presumably more recent. The Notts. record, Carr's Victoria County list, 1906, gives one locality, Cottam, and one ditch for the species. There is only one record for Worcester, J. E. Fletcher in the Victoria County list, 1901, for 'pond, Middleyards'.

Thus the evidence indicates that only a part of the south coast is a breeding centre, and that various individuals or expeditions have succeeded in reaching as far north as Caernarvon and Notts. The Isle of Man record, however, about half-way between the south and north sections, has to be accounted for. It is for a single specimen which I saw in the Bailey collection in Douglas in 1910, and it was labelled 'Bradda, 25.iv.05'.

We may therefore accept the fact that this species is not common in the Isle and the specimen found may have been a wanderer either from the north or south.

As the more northern records of the south section seem mostly to refer to only single localities or even to only one specimen I would hazard the suggestion that if a single specimen taken on the island was not the only representative of the species, then the species will be more likely to have thriven and multiplied on the island if it arrived from the north.

VIII—THE NATURE OF THESE 'INVASIONS'

I have freely written about the arrival of species from the Continent, and it must have occurred to some to wonder whether odd individuals arrive like lone tourists and settle down to produce families. In the early days of a period, while environmental conditions are improving for immigrants, there will presumably be little trouble in securing a foothold; but are a proportion of the new arrivals pregnant females or how do the sexes meet?

Is it not probable that it is not always single individuals that arrive? I think it probable that many species may have periodic or irregular waves of dissatisfaction with the conditions of life, may be lack of food or some other disturbing factor, or just a desire to move elsewhere, and this may become a large or a small epidemic. In some cases such a condition merely causes general dispersal, but in others, due perhaps to some external factor, all follow a definite direction. I have elsewhere, 1953 (17), dealt with occasional mass movements of insects, and I will give a few examples here of what appear to be movements of beetles in a definite direction, but none of them are Scottish water beetles.

1. **Hydrophilus piceus.** This was at one time 'more abundant in the neighbourhood of London than in the country' (Curtis), but it has been found as far north as Northumberland. It is still to be found not uncommonly in some parts of southern England as far west as Somerset. In 1951 and 1952 a number of specimens were taken in a mercury vapour light trap at Westcliff-on-Sea, Essex. In 1955 a male and a female were taken in a similar trap in south-east Kent, and in August of the same year two females were found climbing out of a brackish ditch in South Essex. These may have been immigrants in a migration period.

2. **Cybister lateralimarginalis.** A single specimen was found at Walton, South Essex in 1826. No other specimen was found until 1831, when one was taken in London from an oyster basket from Essex, and again, five years later, a third specimen was found at Southchurch, Essex. Only one explanation seems possible. During those years there seems to have been a definite although very small movement from the Continent to south-east England.

3. **Graphoderus cinereus.** This species was first recorded by Stephens, 1828, whose record was for the first two specimens, a male and a female, taken at Whittlesea Mere, Cambs., in 1825. In 1855 it was recorded from the Cambs. and Hunts. fens by Hamlet Clark, and there is a full series of specimens in the Power collection in the British Museum (Natural History). It was not again found for 49 years, when I discovered a colony of it in East Norfolk, where by 1906 I had found 19 specimens and others had also taken specimens. Then once again the insect disappeared. Its next appearance was in North Hants, where S. E. Allen, a newcomer, found it in

July, 1952, in the Woolmer Bog, and since then a number of collectors have found it there. In July, 1938, I spent several hours collecting on the same ground, where many years ago *Hygrotus 9-lineatus* abounded, but I saw no sign of the *Graphoderus*. As in almost every case where a species is again discovered after a long absence, it seems to have been taken for granted that it had survived somewhere in the country all through the blank period, so it was assumed in this case, even though the distance between the 1904 Norfolk discovery and 1952 Hampshire discovery is at least 150 miles.

I incline to the belief that the original Cambridge and Huntingdon specimens were the product of one invasion from the Continent, the Norfolk specimens of a second, and the Hampshire specimens of a third.

4. **Spercheus emarginatus** was first recorded in Britain by Stephens, 1829, from Yaxley Fen, Hunts., where a pair were taken by Chant in 1824. Shortly after that Curtis described its occupation of 'muddy ditches and stagnant ponds', and stated that it was then very rare in England although 'it must have been taken formerly round the metropolis in some abundance as specimens were preserved in most of the old London cabinets'. In 1939 Ingpen recorded it from Whittlesea Mere, Cambs., 'at roots of aquatic plants'. Its next occurrence was in 1878, when a number of specimens and larvae were found in a ditch in some marshy ground at West Ham, South Essex, where it was found for about four years, and then disappeared either because the ditch was destroyed when a railway was built or before that happened. Nothing more was heard of the species until 1956, when imagines and larvae were discovered near Beccles, East Suffolk.

If an insect after a lapse of some years re-appears where it had been known before, the chances are that it had been there all the time but had not been found, but when an insect turns up after nearly 80 years far from any place it had been previously found, there is some justification for regarding the later occurrence as independent of the previous one. Therefore in this case there is some justification for believing that there have been at least three separate invasions of *Spercheus*.

5. **Calosoma sycophanta.** This is a very attractive Carabid beetle of large size and brilliant colouring. Stephens (1828) wrote of it that the first specimen taken in Britain was found at Southwold, East Suffolk, and shortly afterwards one was taken by a boy in the cloisters of Norwich Cathedral. Since that time it has been found on the Welsh and South Devon coasts, and in 1828 many specimens were sent to Dr. Leach from Dartmouth. It was reported that some were found in Combe Wood, Surrey, an area which used to be famous especially for Lepidoptera. Stephens added, 'I believe it occurs near Oxford and has been taken in Ireland'. It cannot be

said that it 'occurs' anywhere in Britain, but there seem to have been definite invasions, apart from occasional odd specimens arriving.

IX—CONCLUSION

I have endeavoured to show that there is constant movement of water beetles from one centre to another, that there is definite evidence of regular or irregular immigration of these insects from the Continent, and that most of it has been post-glacial and via south and east England.

It will be realized that but for the amount of records I have been able to accumulate, greatly aided by the co-operation of many friends and acquaintances, the work I have set out in this paper would not have been possible, although twice the number of records would have been even more convincing; but I hope that I have set out enough to at least make my case plausible. That the majority of the species reach Britain by the use of their wings is probable, but to what extent they direct their flight is a subject worth investigation, and I have only touched upon it in the last few pages. Miss Jackson's excellent work on the disappearing wings and flight muscles in a number of these water beetles, a process of degeneration which I take to be recent, is going to affect the upkeep of our water beetle fauna if I am right in believing that it is being maintained even to a small extent by immigrants. But it is only by collecting records that we can accumulate material upon which to explore many interesting facts in connection with living things.

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NOTES ON *ARCTIA CAJA* (L.) WITH DESCRIPTIONS OF NEW ABERRATIONS

By S. GORDON SMITH, F.L.S., and J. D. C. BOYES, B.Sc., A.R.I.C., F.R.P.S.

In rearing *A. caja* for over ten years, the main object has been to obtain as many different aberrations as possible. It was soon discovered that it was not easy to obtain a strain that would produce these, for many wild pairings were arranged and reared to the F3 generation without producing a single aberration; such strains were discarded as useless for our purpose.

On the other hand the opposite was the result with some broods kindly given by friends or provided by moths taken in light traps.

By cross pairing and rarely interbreeding beyond the F2 generations, strains have been kept going for up to eight years and have produced a large number of aberrations, some of them new. These aberrations have been described and named by S. Gordon Smith in the following publications:

The Entomologist's Record, Vol. **65**, 1951.

Twelve new aberrations: abs. *paucimacula, rubrociliata, septata, schizomacula, quadricothurnata, albisignata, bijuncta, nigromarginaria, obliterata, nigrovenosa, nubilata* and *fusata.*

Entomologist's Gazette, Vol. **7**, 1956.

Ten new aberrations: abs. *achlyoessa, lutulenta, nigrata, sordida, paurobalia, abdominalis, lunulata, rufa, fusca* and *poveyi.*

Entomologist's Gazette, Vol. **8**, 1957.

Eleven new aberrations: abs. *hectaploa, tapeta, hexacha, pentaploa, pentacha, monosema, upsilon, pinax, taona, clostera* and *aclea.*

Entomologist's Gazette, Vol. **9**, 1958.

Eighteen new aberrations: abs. *leucorhabda, olivaceosuffusa, fuscorhabda, paliscia, tigrina, catarryta, astramenisca, s-signatum, lamprogenys, ditta, osta, pentapunctata, aphenges, pelodes, flavirosea, melanolimbata, prosopia* and *exotica.*

The Entomologist, Vol. **88**, 1955.

One new aberration: ab. *wrighti.*

In addition to the above the following aberrations were reared:

Named by Cockayne: abs. *rubra, diaphana, mediodeleta, albomedia, basicincta, disconjuncta, albistriga, consolidata* and *discolor.*

Named by Stättermayer: abs. *brunnescens, albociliata, nigropennalis, conjuncta, biconjuncta, hebeoides, cingulata, ocellata* and *brunneociliata.*

Named by other authors: ab. *lutescens* Cockerell, ab. *rubrodorsalis* Schulbg., ab. *jeuneti* Oberthür, ab. *flava* Aigner, ab. *syltica* Werneburg, ab. *muecki* Kramlinger, ab. *confluens* Rebel, ab. *flavosignata* Closs, ab. *schultzii* Frings, ab. *juncta* Biezanko, ab. *nigrociliata* Hoffman, abs. *radiata* and *rosea* Gramann.

This makes a total of 88 aberrations, including those we now describe and name, that have been reared; in addition there are many combined aberrations, and there are no doubt more to be discovered.

Most useful has been an ab. *lutescens* male taken at Nantwich, Cheshire, by J. D. C. Boyes in his moth trap in 1958. The progeny of this male together with that of the melanic strain kindly supplied by David Wright in 1955, made the production of ab. *staettermayeri* possible for us.

The method of rearing is the same as detailed in the *Entomologist's Gazette,* Vol. **7**, 1956, by David Wright and S. Gordon Smith.

NEW ABERRATIONS

Arctia caja ab. **coxeyi** ab. nov.

The dark colour of the forewing a rich, warm, bone brown, the main feature of which is a strong single bar composed of the middle component of the triple costal mark plus the inner marginal quadrate mark, with a reduction of the distal element of the triple costal mark to a conspicuous lunule. In this aberration the hindwing is normal.

Type: Female, F3 generation, bred 1959; the first ab. appeared in the F2 generation, and the F3 generation produced a pure strain of ab. *coxeyi.*

Origin: Ova of a typical female taken in the New Forest, August, 1958.

Plate I, Fig. 1. S. Coxey coll.

Arctia caja ab. **luna** ab. nov.

Similar to ab. *coxeyi* in pattern, but with the hindwing colour light orange yellow.

Type: Male, F4 generation, bred 1959. Another pairing of the F2 generation mentioned above produced many ab. *lutescens* Cockerell, which subsequently produced ab. *luna* in the F4 generation.

Plate I, Fig. 2. S. Coxey coll.

Mr. S. Coxey states that this ab. was difficult to pair, very few were reared in the F5 generation, and only two in the F6, both males.

Arctia caja ab. **fringsi** ab. nov.

A remarkable aberration: Forewing with the pattern of ab. *schultzii* Frings, but with the dark markings sepia, darker edged, on a light ground of avellaneous; hindwing fuscous black, the black-edged bluish spots dull but prominent; thorax sepia; abdomen fuscous with a trace of dull reddish, the dorsal bars similar in appearance to the hindwing spots.

Type: Female, F2 generation from a pairing of ab. *schultzii* Frings and ab. *fusca* Gordon Smith, bred from a mixed strain.

Origin: Fulham, Chester and Hants, 1958. Several of this ab. were bred.

Plate I, Fig. 3. S. Gordon Smith coll.

Arctia caja ab. **hepialoides** ab. nov.

This aberration manifests a curious elongate wing-shape, recalling that of *Hepialus humuli* L. Most of the examples exhibit the preponderance of the 'white' ground colour in the forewing as in ab. *schultzii* Frings, although in some cases there are blotches on the termen. Hindwing and abdomen more or less normal. The wing-shape condition is the exact opposite of that found in ab. *poveyi* Gordon Smith, a specimen of which is figured beside it, Plate I, Fig. 6.

Type: Female, F2 generation of an ab. *schultzii* strain. Bred 1957.

Origin: (Norfolk and Hants) and Chester.

Plate I, Fig. 5. S. Gordon Smith coll.

Several of this aberration were bred from the above strain during 1957; occasional examples have also appeared in other broods during 1958 and 1959.

Arctia caja ab. **staettermayeri** ab. nov.

Similar to ab. *brunnescens* Stättermayer in pattern and varying degrees of smoky brownish suffusion but with the orange-red pigment of the abdomen and hindwing replaced by yellow.

Type: Female. Bred F1 generation No. 220 Pairing, 1959, details below.

Origin: A mixture of the following: Nantwich, Fulham, Chester, Norfolk and Hants. A very mixed strain.

Plate II, Fig 1. S. Gordon Smith coll.

Ab. *staettermayeri* appears to be a heterozygote for ab. *nigrata*; see Pairing No. 230 below.

Notes on pairings are given below, and examples of some of the aberrations obtained are illustrated in Plates I to III, and some asymmetrical aberrations in Plate IV.

Pairing No. 220. 5.iii.1959.

Parents, male ab. *lutescens* and female ab. *brunnescens*, produced approximately 26% normal, 11% ab. *brunnescens*, 27% ab. *staettermayeri*, 23% ab. *lutescens*, 4½% ab. *sordida*, 6% ab. *schultzii*, 1½% ab. *divisa* and 1½% ab. *septata*.

Pairing No. 220. 3.v.1959.

Parents, male ab. *brunnescens* and female ab. *staettermeyeri* produced approximately 50% normal, 30% ab. *brunnescens*, 7% ab. *nigrata*, 7% ab. *flava* and 7% ab. *abdominalis*.

The ab. *nigrata* are similar in appearance to those reared from a pairing between two ab. *brunnescens*.

Pairing No. 195. 6.ix.1958.

Parents, male (from a pairing of ab. *lutescens* and normal) and female ab. *nigrata* produced (in the F1 and F2 generations combined) abs. *lutescens, staettermayeri, brunnescens, fusata, divisa, schultzii, melanolimbata, lunulata, nigrata,* and in addition combined abs. of *brunnescens-conjuncta, brunnescens-divisa, fusca-divisa and fusca-conjuncta.*

Pairing No. 197. 6.ix.1958.

Parents, male (from a pairing of ab. *lutescens* and normal) and female ab. *brunnescens,* produced (in the F1 and F2 generations combined) abs. *brunnescens, lutescens, staettermayeri, fusata, divisa, diaphana, nigrata, hepialoides, fuscorhabda,* and in addition combined abs. of *brunnescens-conjuncta, brunnescens-mediodeleta, lutescens-mediodeleta, astramenisca,* with thinly scaled thorax and abdomen.

Our thanks are due to Mr. J. Povey for the care and attention he has given to the rearing of the larvae and other matters.

We are very grateful to Mr. W. H. T. Tams for his advice in compiling this paper and assistance in describing the aberrations.

(Colours from Ridgway's *Color Standards and Color Nomenclature,* 1912.)

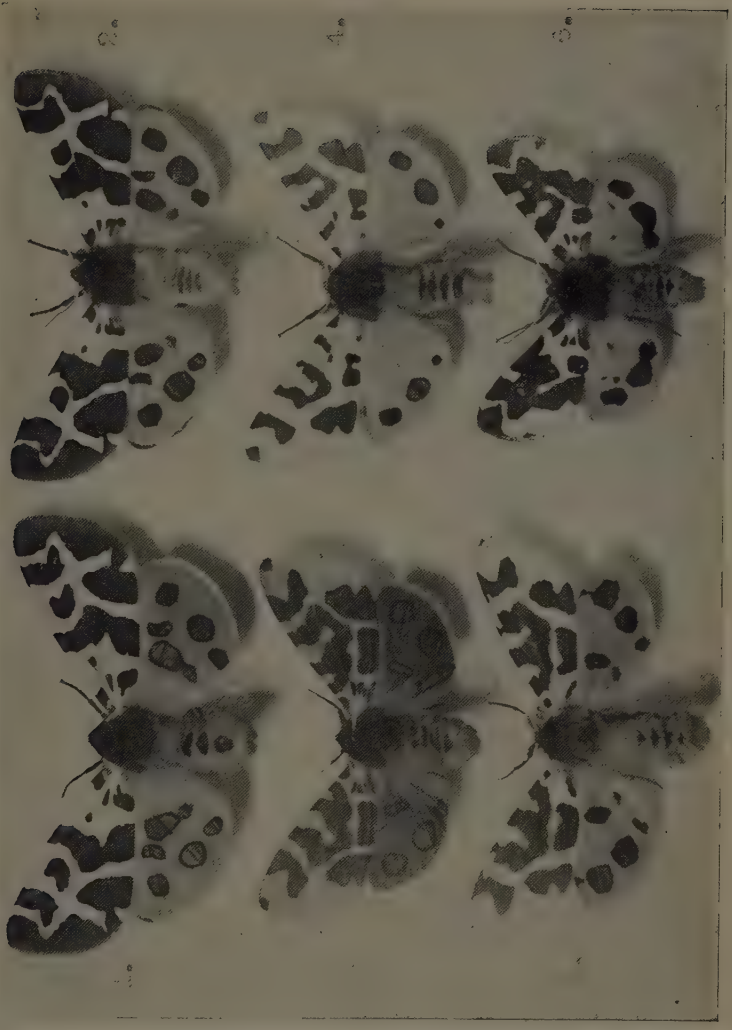

Photo by Will R. Rose Ltd.

ABERRATIONS OF *ARCTIA CAJA* (L.)

1. Ab. *coxeyi* Gordon Smith and Boyes.
2. Ab. *luna* Gordon Smith and Boyes.
3. Ab. *fringsi* Gordon Smith and Boyes.
4. Combined ab. *schultzii*, ab. *divisa* Cockayne, and ab. *muecki* Kramlinger.
5. Ab. *hepialoides* Gordon Smith and Boyes.
6. Ab. *poveyi* Gordon Smith.

Photo by Will R. Rose Ltd.

ABERRATIONS OF *ARCTIA CAJA* (L.)

1. Ab. *staettermayeri* Gordon Smith and Boyes.
2. Ab. *staettermayeri,* a dark specimen.
3. Combined ab. *divisa* Cockayne, ab. *ocellata* Stättermayer and ab. *staettermayeri.*
4. Combined ab. *schultzii* Frings, ab. *confluens* Rebel and ab. *staettermayeri.*
5. Combined ab. *lutescens* Cockerell and ab. *schultzii* Frings.
6. Combined ab. *lutescens* and ab. *astramenisca* Gordon Smith.

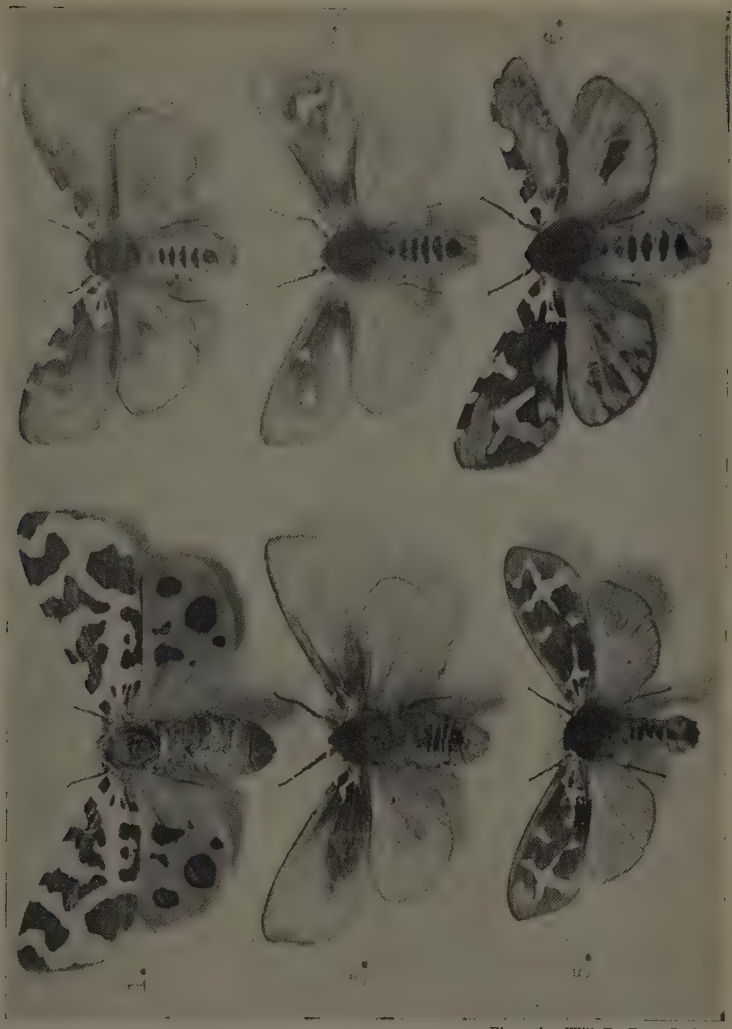

Photo by Will R. Rose Ltd.

ABERRATIONS OF *ARCTIA CAJA* (L.)

1. Ab. *astramenisca* Gordon Smith, this specimen was bred from No. 197 pairing, which produced several ab. *diaphana,* all of which have thinly scaled wings with normal thorax and abdomen; this moth and a few others have thinly scaled thorax and abdomen, with the wings normal in this respect.
2, 3, and 4. Ab. *diaphana* Cockayne, all from No. 197 pairing.
5. Ab. *diaphana* Cockayne.
6. An aberration with thinly scaled wings, abdomen ground colour yellow, a remarkable specimen unfortunately with a deformed right wing, could be classified as a combined ab. *lutescens* Cockerell and ab. *diaphana*

Photo by Will R. Rose Ltd.

ABERRATIONS OF *ARCTIA CAJA* (L.)

1. to 6. Asymmetrical specimens reared from different broods.

NYMPHALIS POLYCHLOROS L. (LEP., NYMPHALIDAE) IN KENT: FURTHER RECORDS OF ITS OCCURRENCE TO 1959

By J. M. CHALMERS-HUNT

An account of *N. polychloros* in Kent by D. F. Owen and myself was published in *Ent. Gaz.*, **4**: 3-11, 1953.

This dealt with its history, distribution and status in the county, and covered the period from the earliest known records up to 1952.

A number of interesting records not included in the above-mentioned account have since been traced and are reproduced here as a supplement. There are also records of the occurrence of *polychloros* in Kent for the period 1953-1959.

EARLIEST RECORDS TO 1952: ADDITIONS

1843: Between Shooters Hill and Footscray, April, on one day hundreds of *V. io*, *V. polychloros* and *V. urticae* seen (J. W. Douglas, 1843, *Zoologist*, **1**: 177).

c.1857: Knock Wood, near Tenterden (S. C. Tress Beale Diary, *per* G. V. Bull).

1860: Lee, 29th April; Bexley, 1st May (Fenn MS.).

1874: Near Dartford, full fed larva taken by A. H. Jones, 27th June (Fenn Diary).

1875: Kingsdown district, one 1st August (Fenn Diary).

1888: St. Margaret's Bay, one 25th August (Fenn Diary).

1893: Chattenden, several seen 17th June (Fenn Diary).

1925: Folkestone Town, one July (R. G. Warren *in litt.*).

1929: West Wickham, one (Sankey, 1944, *Kent J.*, **6**: 19).

1934: Edenbridge, one 5th March (F. D. Greenwood *in litt.*).

[In *Ent. Gaz.*, **4**: 3-11, 1953, we gave the date as 1936 in error; also the recorder's initial is corrected here.]

1935: Tunbridge Wells, 1st April, A. H. C. Morse (T. Dannreuther *in litt.*).

1936: Canterbury, August (J. S. Wacher).

1940: Trottescliffe, two seen (H. E. Hammond).

1942: Tonbridge, one hibernating in a room, 8th July, Stelling Minnis, two including one at buddleia, 9th August (J. S. Wacher).

1945: Whitstable, one dead in house (D. G. Marsh).

1946: Goudhurst, July, one hibernating indoors (W. V. D. Bolt).

1947: Goudhurst, one 5th March (W. V. D. Bolt).

1947: Fawkham, one July (G. G. E. Scudder *in litt.*).

1948: Near Shorncliffe Station, larvae on elm, May (J. H. Platts, 1952, *Proc. S. Lond. ent. nat. Hist. Soc.*, 1951-52: xv).

1949: Burham Down, one (W. A. F. Cameron *teste* A. J. Woodcock *in litt*).

1950: Burham Down, one (*ibid.*).

1952: Broadstairs, one 16th March, in a church (A. Lowings *teste* W. D. Bowden); Ashford, one 20th July (P. Cue).

Records From 1953-1959

It is interesting to record that from 1953 to 1959, so far as I am aware, a total of only four specimens have been noted in the county: these are as follows:

1953: Brook, one April (C. A. W. Duffield *teste* E. Scott); Boxley, one (A. H. Harbottle *in litt.*).

1954-7: None. 1958: Westwell, one 5th September, E. Scott; Folkestone, one 4th September, K. Self (Scott, 1958, *Bull. Kent Field Club,* **4**: 20; French, 1959, *Entomologist,* **92**: 173).

In conclusion I wish to express my thanks to all those who have supplied me with records, and whose names appear among the authorities given above.

BOOK REVIEWS

The World of Insects, by Paul Pesson. English edition translated by R. B. Freeman. 1959. 4to pp. 204, 228 plates (176 in gravure, 52 in colour). The Living Nature Series. George G. Harrap & Co. Ltd., London. Price £3 3s.

A book on a subject as vast as that of the world of insects must be selective, and the author accomplishes this difficult task well. The text is factual, informative, and written in a style likely to appeal to the general reader and student alike, and, if such an expression may be used, has been beautifully translated. Various aspects of insects as a whole are covered, including their origin and evolution, adaptiveness and widely differing modes of living and physiology. It is mainly other orders which are taken as examples in both text and illustrations, a separate volume on the Lepidoptera having appeared in the same series.

This book will appeal to many for its illustrations alone, which the large format has enabled to be reproduced in luxurious style. The numerous black and white illustrations include some remarkable photographic studies, as also do those in colour, and are culled from many sources. Their quality is such that on seeing them one is tempted to buy the book.

J.D.B.

Biologie der westpaläarktischen Raupenfliegen DIPT., TACHINIDAE, by Dr. Benno Herting, *Monographien zur angewandten Entomologie, beihefte zur Zeitschrift für angewandte Entomologie,* 1960, 188 Seiten mit 12 Abbilgungen, Broschiert, 32 DM, Für Abbon. d. *Ztschr. f. angew. Entomologie* 28 DM, Verlag Paul Parey, Hamburg u. Berlin.

After more than a decade of chemical control of insect pests, with its attendant hazards, it is pleasing to note the recent return of interest in biological control.

This revival has created a need for works summarizing the scattered literature on insect parasites. Dr. Herting's book provides just such a summary for a very important group of parasitic insects, the Dipterous family Tachinidae.

The last work of this kind was that of Baer published 40 years ago. Since then Audcent (1942) has published a host list of British Tachinidae, but the only general work has been the series of Parasite-Host catalogues published under the direction of W. R. Thompson. Both these later works have been essentially lists and no discrimination has been made regarding the accuracy of records. The work under review is a critical survey of the subject.

The female reproductive system and the morphology of egg, larva and puparium are described in the first chapter. Characters of taxonomic importance are illustrated and the details of mouth parts and spiracular structure are clearly indicated. Dr. Herting has discussed elsewhere (1956, *Z. Morph. Okol. Tiere,* **45**: 429-461) the value of the female genitalia in the systematics of the Calyptrate Diptera, and in the present work the results of these studies, in conjunction with biological evidence, are reflected in the classification adopted.

A chapter on oviposition and infection of the host is considered under two main sections according to whether eggs are laid directly upon the host or free of the host. Within these sections some of the more familiar biological groupings of Pantel are evident. This follows the more logical treatment proposed by Van Emden, reflecting the phylogenetic development.

The endoparasitic habit in Tachinidae is then discussed and the various types of development described. Short chapters on the puparium, adult habits, enemies, hyperparasites and diseases precede the main section of the work. This chapter is a systematic treatment of the west palaearctic Tachinidae with comments upon the recorded insect hosts and biology of each species. Full references to the literature are given against each host. Four subfamilies are recognized: Exoristinae, Echinomyiinae, Dexiinae and Phasiinae. One new species of *Eucarcelia* Bar. is described (page 88). This revival of Baronoff's (1931) name for a group of *Carcelia* which parasitize naked or sparsely haired lepidopterous larvae indicates the biological approach behind the classification and nomenclature adopted. This classification

may be studied in full in a taxonomic revision of the European Tachinidae which Herting is publishing elsewhere. The last section of the work is a systematic list of hosts with the names of their parasites appended. A very full bibliography of 16 pages is given and an index to genera and species.

Dr. Herting's monograph has come at a very opportune moment when much work on biological control is in progress. It will be an indispensable work of reference to all entomologists engaged in ecological studies involving Tachinidae as parasites.

K. G. V. SMITH.

IRISH RECORDS OF THE HUMMING-BIRD HAWK-MOTH IN 1959

Co. DUBLIN: Howth, 6th July (4), first three weeks in Sept. (2 or 3 most days); Rathfarnham, 29th and 30th July, Oct. (2); Monkstown, mid-July (5), 5th Oct.; Blackrock, 9th Sept., mid-Oct. (5), 4th Nov.; Killiney, 23rd Oct.; Dun Laoghaire, Aug. (1), Sept. (1); Lusk, 4th Oct.; Coolcock, mid-June (1).

Co. WICKLOW: Newtown Mountkennedy, 28th April, 13th July; Killcool, 16th June, 5th July; Newcastle, 5th, 7th and 9th July; Enniskerry, 20th and 21st August.

Co. KILDARE: Naas, 24th and 28th July; Straffan, 1st and 29th July, 29th Sept.; Athy, early July (1), early Sept. (1), late Sept. (1); Brannockstown, late Sept. and early Oct. (4).

Co. WESTMEATH: Killucan, 2nd June, July to Sept. (5); Athlone, 11th Oct.

Co. OFFALY: Tullamore, early Oct. (1).

Co. CARLOW: Rathvilly, Sept. (1).

Co. GALWAY: S. W. Connemara, 7th Oct.

Co. LIMERICK: Limerick, Sept. (1), Oct. (20).

Co. WEXFORD: Clonard, 11th Sept. (2); Great Saltee Is., 23rd Oct.

Co. WATERFORD: Helvick Head, 31st July (about 200 counted to about a quarter-mile of cliff).

Co. CORK: Skibbereen, 21st July (2), Aug. (8).

Co. KERRY: Caragh Lake, 26th Oct.; Valentia Is., 13th and 15th October.

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Glenageary, Co. Dublin.

OBSERVATIONS ON THE REACTIONS OF SOME MOTHS TO THE PROLONGED SPELL OF DRY WEATHER

On the night of 10th April, 1960, at Kincraig, Inverness-shire, rain fell after a period of dry weather with strong northerly winds. Commander G. W. Harper and I were surprised to see several Noctuids on the wet stems of ling, bilberry and young birch, imbibing from the droplets of water there. Specimens of *Conistra vaccinii* L., *Orthosia gothica* L. and *O. stabilis* Schiff. were seen with the proboscis extended and probing the moisture. There were no aphids about, nor were the young birches exuding sap. I could detect no trace of sweetness in a sample of the moisture applied to the tongue, and I can only conclude that the moths were compensating for excessive water loss due to the prevailing conditions. I had not noticed this type of behaviour before.

Yesterday, 5th May, was hot and sunny. I visited one of the Buckinghamshire localities of *Xanthorhoe biriviata* Borkh. and was distressed to find that most of the large timber had been removed since my last visit. The balsam was locally abundant, but gone was the deep shade and humidity that had been so characteristic of the spot. Minnion (1957, *Ent. Gaz.*, **8**: 190-191) suggests that shade is a necessary feature of the habitat of *biriviata*, and other observers seem to agree. Yesterday, in the hot sun, the moths were very active, dashing off the trunks of the few remaining trees at my approach: time 12.30-1.30 B.S.T. At 1.55 I noticed several of the moths flying slowly about six inches above the surface of a small puddle in the wood, and settling on the mud at the edge. They were skittish, and I was not able to approach close enough to be certain that moisture was being imbibed, though I believe that to be the case. When the moths were disturbed they flew right away, but I made a point of returning to this and another puddle at intervals of about 10 minutes until 3 p.m., and each time one or more *biriviata* were present and behaving in the manner I have described. The early afternoon flight of the species is well known (Minnion, *loc. cit.*), but I have not heard of the insect attending puddles. I conclude that the behaviour is associated with the dry weather and the altered habitat.

B. GOATER.

71 Grant's Close,
London, N.W.7.
6th May, 1960.

THE EMERGENCE OF AN *APATURA IRIS* LINNAEUS

By I. R. P. HESLOP

In the April 1955 issue of the *Entomologist's Gazette* (Vol. 6, p. 69) there was published a paper by myself entitled 'The Breeding Log of an *Apatura iris* in 1954'. In this were given timed observations, in great detail, of the rearing of a Purple Emperor from just before the last moult of the larva until the emergence of the perfect insect. But the actual act of emergence was not witnessed. On several occasions subsequently I missed—often by the narrowest of margins, since the process is a swift one—seeing the imago of this species emerge. And it was not until last year, 1958, that I eventually had this pleasure, when, on 9th July, I witnessed the whole act of emergence of a large male specimen. In this luck favoured me, since I had very many other calls on my time—especially in consequence of my employment.

The following then is a transcript in this connection from my Log Book. All times given are by British Summer Time. The larva was taken in Sussex on 12th October, 1957.

4th July, 1958: Friday. Arrived home [Burnham-on-Sea] 6.10 p.m. Found the first trace of colour change in pupa. Sprayed it: no shaking. Watered plant.

6th July: Sunday. Pupa beginning to assume a papery texture. Sprayed it. Again no response.

7th July: Monday. At 6.0 a.m. I detached sprig holding pupa and placed it, secured with cotton wool, upright in a water-filled glass phial in puparium. I then placed the puparium in the car. I set out at 7.05 a.m., arriving at Salisbury at 9.35. I placed the puparium in my room, and at 10.0 a.m. sprayed the pupa. It shook itself vigorously three times, in response to mechanical stimulus. Very warm to-day.

8th July: Tuesday. Really hot to-day. Sprayed pupa in morning, no response. From 5.45 p.m. to 6.45 it was placed in direct unimpeded sunlight, position being varied from time to time. Sprayed at 8.50 p.m. To my relief a good strong reaction was obtained when pupa was touched with a solid object. Sprayed again at 10.30 p.m.: no reaction. When adjusting the sprig, the leaves of which were now drooping, I caught the head process of the pupa in the cotton-wool plug of the phial neck. This resulted in a very considerable jerk, which must have severely tested the attachments; and which for a moment I thought might have damaged the head. (*Note.* Pupa's lack of response to spraying stimulus appears to be due only to lack of ability during last few days in this state to hold water; since it will still respond to other stimuli, e.g. touching with a blade of grass.)

9th July: Wednesday. At 6.45 a.m. pupa was a little darker only.

(*Note.* It appears that *iris* reared on the richer and better-fed strains of Broad-leaved Sallow have thicker envelopes to their pupae: with the result that there is much less 'darkening' apparent before emergence.) At about 12 o'clock there was no further change in colour, but a faint transverse crack had appeared in left side. At 1.0 p.m. there were one or two other faint transverse cracks appearing on this side (which throughout had been towards the light). At 1.40 there was a slight agitation, which continued sporadically. At 1.45, just as the bell for afternoon class was ringing (a little late), the first crack suddenly split open while I was watching. A few seconds later a ragged diagonal tear appeared on the left side, running across the first crack and terminating on the dorsal surface not far from the head. There was a glow of purple; and then further agitation.

At 1.50 p.m. the imago, a male, emerged through this tear, i.e. from between the lateral and dorsal surfaces and at some distance from the head. He immediately climbed down from the pupa-case to the underside of the leaf below, and hung there wings downward. By two o'clock he was fully developed, though the wings were still limp and not quite straight. He stirred them slightly. By 2.25 wings were quite dry and straight.

At 4.0 p.m., when I went out, he was still hanging from the underside of the same leaf. Before going out I placed my gown over the puparium (which also contained a freshly emerged *ligustri*). At 6.30, when I came back and removed the gown, the *iris* was found to be upright on the upper surface of another leaf: and the *ligustri* to have moved to the other side of the cage. From 6.30 to 6.45 the Emperor was walking rapidly about the Sallow sprig, sometimes upright and sometimes wings downwards. Just after seven o'clock he displayed beautifully and then dropped to the floor of the cage, where he moved about a little and then started to imbibe moisture from a pad. At 7.50, though the puparium was in very subdued light, he flew up nearly to the top of the gauze, where he settled down. At 7.58 he changed his position by a few inches and then turned upside down. The forewings were very erect, but after a few seconds he clasped them with a sudden jerk. At 8.08 he displayed again; and again at 8.15. At 8.17 he went for a considerable walk; and at 8.21 flew on to the Sallow sprig where, after a moment's display, he closed and then clasped his wings (resting wings downwards). His head was higher than his abdomen. I drew the curtain and left him to go to my supper. At 8.40, in near darkness, I found him still on same leaf, but with wings now upright: head lower than abdomen. At 10.55 p.m. he moved to top part of sprig, and sat with wings upright.

'Belfield,'
Burnham-on-Sea, Somerset.
25th August, 1959.

THE ISLES OF SCILLY IN 1959

By ROBIN M. MERE

I spent from 8th to 15th July, 1959, on Tresco with Mr. John D. Bradley. There was a drought, which was not assuaged by a short sharp shower that caught us unprepared as we were examining the contents of a trap early one morning. There was a cool easterly wind most of the time, and the weather was entomologically unfavourable, though pleasant for holidaying.

Mr. H. C. Huggins spent four weeks on Tresco, arriving in June and leaving about a week later than us. We benefited from the pleasure of his company, not only accompanying him before 6 a.m. each morning to inspect the several mercury vapour light traps, but collecting together on Tresco and visiting Tean.

Migrants were few, and none of outstanding interest was seen. We did find a few species not previously recorded, and Mr. Huggins found a few more which were of rather more interest. He has authorized me to include his records in this present note. The new insects were as follows:

Ostrinia nubilalis Hübn. One specimen taken by Mr. Huggins.
Stenoptilia bipunctidactyla Haw.
Cnephasia chrysantheana Dup. Seen by Mr. Huggins.
Bactra furfurana Haw. First taken by Mr. Huggins and later by us.
Endothenia antiquana Hübn.
Caryocolum semidecandrella Threlf. First taken in 1958 and again in 1959, but not identified until the early months of 1959.
Stomopteryx anthyllidella Hübn.
Coleophora glaucicolella Wood.
C. laripennella Zett.
Gracillaria phasianipennella Hübn.
Plutella annulatella Curt.
Opostega salaciella Treits.

The occurrence of *Thiodia citrana* Hübn. was verified, the insect being found to be quite common on St. Mary's, and also being taken on Tresco.

Our grateful thanks are again due to Commander Dorrien-Smith for his kindness in permitting us to visit and collect in the wonderful garden of Tresco Abbey.

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